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Industrial Economics: An Overview

Richard L. Schmalensee
Sloan School of Management
Massachusetts Institute of Technology

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MASSACHUSETTS
INSTITUTE OF TECHNOLOGY
50 MEMORIAL DRIVE
CAMBRIDGE, MASSACHUSETTS 02139

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Two decades ago George Stigler (1968, p. 1) described the boundaries of industrial economics or, as the field is frequently labeled, industrial organization:

> ... there is no such subject as industrial organization. The courses taught under this heading have for their purpose the understanding of the structure and behavior of the industries ... of an economy. These courses deal with the size structure of firms (one or many, "concentrated" or not), the causes ... of this size structure, the effects of concentration on competition, the effects of competition upon prices, investment, innovation, and so on. But this is precisely the content of economic theory -- price or resource allocation theory ...

Stigler went on to note that industrial economics deals not only with theory but also with measurement and hypothesis testing and with the analysis of public policies toward business. A fairly accurate capsule description is that industrial economics is the study of the supply side of the economy, particularly those markets in which business firms are sellers.

Industrial economics emerged as a distinct field after the rise of the large modern manufacturing corporation around the turn of the century (Chandler (1977), Hay and Morris (1979, ch. 1)). For many years it was generally viewed as an intellectually isolated empirical field without much scope for formal theory or non-routine econometrics. But in the last two decades much of the significant work in industrial economics has been theoretical, and much of it has been produced and consumed by non-specialists. The game-theoretic tools now generally used in this research (and regularly sharpened thereby) are described in Section I. The late 1980's seems to have witnessed a shift of interest back to empirical

studies, and Section I also provides a brief overview of the methods that have been developed and employed in this work.

Industrial economics is now best defined by three main topical foci, two of which are discussed systematically in what follows. Section II considers determinants of the behavior, scale, scope, and organization of *business firms* Research in this broad area has spilled over into labor economics and corporate finance and has informed the study of the relation between corporate strategies and organizational structures (Caves (1980)).

The second focus is *imperfect competition*. When the structural prerequisites of perfect competition are not satisfied, how do market *conduct* and *performance* depend on relatively stable observable variables -- that is, on market *structure*, broadly defined? When will rivalry be intense, so that rents are dissipated, and when will it be restrained, so that performance is nearly monopolistic?[1] Work on these core questions is discussed in Sections III and IV. Section III considers choices of price, output, and capacity, while Section IV deals with non-price rivalry: product selection, advertising, and technical change. Models of imperfect competition developed in industrial economics have been imported into the scientific and policy sides of international economics (Krugman (1986)) and, recently, macroeconomics, and have been employed prescriptively to determine business strategies (Porter (1980)).

The third focus is *public policy toward business*. One normative question and two positive questions arise here. The normative question has been central to the field since it began: What policies are optimal? Historically industrial economists have concentrated on antitrust (or competition) policy, regulation, and government enterprise. In recent

years they have paid increasing attention deregulation, liberalization of entry restrictions, privatization (Vickers and Yarrow (1988)), and industrial policies aimed at affecting technical progress and international competitiveness (Krugman (1986), Yarrow (1985)). Length restrictions preclude systematic discussions of all these policy domains. Instead, I discuss policy implications of research findings at several points in Sections II-IV and offer a few general observations in Section V.

Length restrictions also preclude a systematic review of attempts to answer the two related positive questions. The first is the natural complement to normative studies: What are the effects of actual policies? Specific answers of course vary considerably, but it is clear that governments often intervene in markets in ways that do not enhance efficiency. Stimulated in large part by Stigler's (1971) discussion of the discrepancy between economic theory and political practice, industrial economists have addressed a second positive question: What determines actual policies? These scholars have encountered a substantial number of political scientists also using rational actor models to study policy formation.

The topical and methodological breadth of industrial economics, the pace at which it has developed in recent years, and limits on the length of this essay confine me to a broad overview of research on some central topics.[2] Comprehensive expository surveys are provided in Schmalensee and Willig (1989) and Tirole (1988); I have drawn heavily on those works and recommend both to the reader who wishes to learn what lies behind the many facades displayed in this essay.

I. TOOLS AND METHODS

This section provides a brief overview of research methods in industrial economics that is designed to complement the substantive discussions that follow. The tools employed in theoretical research, which are considered first, have become more uniform in the last decade, while the methods used in empirical work have become more diverse.

Theory of Strategic Behavior

Except where monopoly is assumed and the possibility of entry is assumed away, theoretical research in industrial economics today employs the tools of noncooperative game theory.[3] Modeling typically begins with the specification of the *extensive form* of a game: a description of which players move when, the actions and information available at each move, the probabilities of any random events to be chosen by "nature," and the functions determining each player's payoff.[4] Some information may be *private*; each firm may know only its own cost function, for instance. Other information may be *common knowledge*; all firms may know the market demand function, for instance, and also know that all other firms have this same information as well.

It is then assumed that observed behavior will correspond to a *Nash equilibrium* of the specified game, a situation in which each firm's *strategy* (a list of the moves it will make in all possible situations) is a best response to the strategies of its rivals. Nash equilibria can involve *pure strategies* (conditional choices of actions) or *mixed strategies* (conditional choices of probability distributions over actions). Equilibria involving only pure strategies seem generally to have more intuitive appeal.

In game-theoretic terms, the familiar Cournot model is a one-period game in which N firms ($N \geq 2$) simultaneously choose output levels of identical products. If Q is total output, and P(Q) is the market inverse demand function, which is assumed to be common knowledge, sellers' payoffs are given by their profit functions:

$$\Pi_i = q_i P(q_i+q_{-i}) - C_i(q_i), \qquad i = 1,\ldots, N, \tag{1}$$

where q_i is firm i's output and $q_{-i} = Q - q_i$ is the total output of its rivals. The first-order necessary conditions for each q_i to be a best response to the corresponding q_{-i} are as follows:

$$\partial\Pi_i/\partial q_i = P(Q) + q_i P'(Q) - MC_i(q_i) = 0, \qquad i = 1,\ldots, N, \tag{2}$$

where MC_i is firm i's marginal cost, dC_i/dq_i, and $P'(Q) = dP(Q)/dQ$. A Nash equilibrium in pure must be a solution to equations (2).[5]

Perhaps the greatest merit of the game-theoretic approach is that it disciplines theoretical discussion by, in effect, forcing theorists to specify and then abide by the rules of the games they analyze. There is no place in the analysis of the basic Cournot game for discussions of conjectured rival response, for instance; the (unbounded) rationality of all players is common knowledge in this game and most others. Similarly, dynamic adjustment paths can only arise in more complex games that unfold over time. And imperfections or asymmetries in information give rise to different games and thus cannot be handled informally. Since market behavior often involves making decisions over time or without full information, much recent work has involved games with these features.

Dynamics While time is most naturally treated as continuous in many situations, continuous-time dynamic games (usually called differential games) are technically more challenging than discrete-time games, and the latter dominate the literature. These can be solved by working backwards from the last period if there *is* a last period. Infinite-horizon games are often more appealing in principle and, where stationarity can be exploited, simpler to analyze. But they typically have equilibria that do not appear even in the limit of the corresponding finite-horizon games.

The analysis of multi-period games in industrial economics relies heavily on the principle of *(subgame) perfection.* Roughly, in a (subgame) perfect Nash equilibrium each player's strategy is a best response to those of its rivals, subject to the constraint that no player's strategy can involve threats that it would not be the player's interest to carry out if his bluff were called. For example, a strategy involving reducing price to zero if any entry occurs contains a threat that is not generally credible (because it generally does not maximize post-entry profits) and is thus ruled out by the perfectness restriction.

In a variety of economic settings the ability to make credible threats can induce other actors to behave "nicely" to avoid the threatened behavior. Much attention has accordingly been devoted to devices that firms can use to obtain credibility. These generally involve taking irreversible actions, which would often be undesirable except for their impact on the incentives and behavior of others, and go under the general heading of *commitment.* If an established monopolist could build a Doomsday Machine (as in the film *Dr. Strangelove*) that would somehow force it to drive market price to zero if entry occurred, and if it could make the existence of that device common

knowledge, it could credibly deter entry. The ability to commit often (but not always) gives an advantage to the first player to move in economic games.[6]

Much interest in recent years has attached to *repeated games* or *supergames* -- in which a relatively simple *constituent* or *stage* game (such as the one-period Cournot or Prisoners' Dilemma games) is played repeatedly by a fixed set of players. Strategies of simply playing Nash equilibrium strategies of the constituent game in each period form a Nash equilibrium of the repeated game. But strategies in the repeated game may involve taking actions conditional on past history, and there are usually many other equilibria when the horizon is infinite. In fact, many of the main results in the supergame literature are variants on the so-called *Folk Theorem*, which says that virtually any set of payoffs can arise in a perfect equilibrium if the horizon is long enough and the discount rate is low enough (Fudenberg and Maskin (1986)).

Information Players are said to have *incomplete information* if they do not know their opponents' payoff functions and to have *imperfect information* if they do not observe the actions of all players. Most interest has attached to games in which information is incomplete and asymmetric. Each firm in a Cournot setup might know its own costs, for instance, with the probability distribution from which cost function parameters are drawn assumed to be common knowledge.

In multi-period games with incomplete or imperfect information, it is natural to require players to optimize at each move using subjective probabilities that they update according to Bayes rule. This requirement yields *Bayesian Nash equilibria*. In such equilibria, actions in any period

may affect other players' actions in future periods by altering their beliefs. These models thus often exhibit *generalized signalling* (Milgrom and Roberts (1987)): costly actions are taken for the purpose of altering other actors' beliefs. Since all parties are rational, such signalling cannot bias any player's beliefs on average but may nonetheless occur because all players interpret their observations in light of others' incentives to induce bias. Multiple equilibria are the norm in multi-period games of incomplete information, and Folk Theorems indicate that a small amount of incomplete information can produce almost any equilibrium payoffs when the discount rate is low and the horizon is long (Fudenberg and Maskin (1986)).

A particularly interesting class of games of asymmetric information is explored in *agency theory* (Hart and Holmstrom (1987)). In the basic agency problem, one party (the principal) hires another (the agent) to act on his behalf in the first period. The principal can generally observe the consequences of the agent's action second-period , but his information about that action (e.g., the level of managerial effort) or about the relevant environment (e.g., the level of demand) is inferior to that of the agent.[7] The principal's task is to design a compensation scheme based on observables in order to maximize his own utility or wealth, subject to the constraints that he be able to hire an agent and that the agent will then act in his own self-interest, as defined by the compensation scheme.[8]

Approaches to Empirical Research

The early years of industrial economics were marked by the production of a number of book-length industry studies, often relying heavily on information

made public during antitrust cases. These comprehensive works remain a rich source of examples of business behavior, such as the evolution of price leadership in the interwar U.S. cigarette industry (Nicholls (1951)), that seem to involve the exercise of monopoly power. This literature also provides a sense of business reality and a detailed understanding of particular markets not frequently encountered in more formal studies. But relatively few industry studies of this sort have been done in recent years.

Inter-industry Studies In the early 1950's, Joe Bain (1951, 1956) shifted the focus of empirical research in industrial economics away from industry studies by showing the apparent power of statistical analysis of industry-level cross-section data. This approach seemed to promise more rapid and objective development of general relations than the case study approach. Most of the cross-section studies that filled the journals during the 1960's and 1970's used government-supplied data and ran regressions designed to "explain" differences in industry-average profitability.

Critics of this research strategy have noted serious limitations of available data. Government statistics often ignore foreign competition and regional markets and define industries that do not correspond to economic product markets. Accounting profitability is at best a noisy measure of economic profitability; problems include the accounting treatments of inflation, advertising, and depreciation (Fisher and McGowan (1983)).[9] There is no fully satisfactory way to handle diversified firms that operate in multiple markets. In addition, it is difficult to construct defensible proxies for a number of variables, including expectations and fundamental attributes of products and technologies, that are important in theory. If unobservable variables are correlated with the independent variables used in

cross-section regressions, as often appears likely, coefficient estimates will be biased.

A second set of criticisms turns on the difficulty of using cross-section data to identify key structural parameters. Economists usually argue that cross-section studies can reveal differences among long-run equilibria as long as deviations from equilibrium are uncorrelated with independent variables. But in the long run almost all observable industry-level variables are affected by firms' decisions and are thus logically endogenous. While lack of identification is not an absolute bar to inference (Breusch (1986)), its definitive symptom, the existence of more than one plausible structural interpretation of estimated parameters, is frequently encountered in the cross-section literature.

Despite these problems, inter-industry studies have an important role to play. It is difficult to design broad public policies, such as antitrust and tariff policies, without a feel for the main economy-wide relations (structural or otherwise) among affected markets. A number of recent inter-industry studies rely on specially constructed data sets to deal with some of the problems noted above. Comparisons between matched industries in different countries, for instance, hold constant a host of unobservable industry-specific quantities (Pryor (1972), Baldwin and Gorecki (1985)), while industry-level panel data can reveal the effects of macroeconomic conditions and permit analysis of stability and change (Domowitz, Hubbard, and Petersen (1986)). Interview and survey methods can provide information not otherwise available (Scherer, *et al* (1975), Levin, *et al* (1987)).

A great deal of interest has recently attached to the use of firm-level panel data (Mueller (1986)). While there are significant differences in

industry-average profitability, there are often even greater differences within industries (Schmalensee (1985)), and variations in the performance of leading firms over time is often not well explained by changes in the industries in which they participate (Cubbin and Geroski (1987)).

Econometric Industry Studies Many industrial economists have reacted to the limitations of the inter-industry approach by studying particular industries. Industry-specific studies cannot describe economy-wide patterns, but, like the earlier case-study literature, such research can provide reliable data points that can inform both theorizing and inter-industry research. A number of studies involve comparisons of geographically isolated markets for a single product and thus hold constant unobservable industry-specific variables (Benham (1972)). Such variables are also held constant in before-and-after analyzes of the effects of exogenous industry-specific structural changes (Rose (1987)).

In the last decade or so, changes in stock prices over short periods have been employed with increasing frequency in industrial economics (Schwert (1981)).[10] On the widely-accepted assumption that the stock market makes full use of publicly available information, stock price changes over some period, corrected for movements in the market as a whole, give the expected present value of the change in profit associated with firm-specific or industry-specific events of that period.

In recent years many authors have used firm-level panel data to estimate industry-specific structural models designed to reveal directly the intensity -- and sometimes the pattern -- of rivalry. Research of this sort invólves particularly heavy investment in data set construction and in developing modeling strategies tailored to available data. Accordingly, a

host of techniques for econometric industry analysis have been developed, but most have been employed only once or twice.

Much of this literature has been concerned with estimation of variants of the following quasi-supply relations:

$$P = MC_i(q_i, X_i) + (1+\lambda_i)q_i P'(Q,Z) \qquad i = 1, \ldots, N. \tag{3}$$

If the λ_i are all zero, equations (3) are just the Cournot first-order conditions (2) with the addition of exogenous variables X_i and Z that shift firm i's cost and market demand, respectively. The λ_i are *conjectural variations* that are best interpreted as reduced form parameters that summarize the intensity of rivalry that emerges from what may be complex patterns of behavior. If estimated λ's are all equal to minus one, sellers behave as if perfect competition prevailed; higher values of λ correspond to larger (P-MC) gaps and thus to less intense rivalry (Iwata (1974)).

Marginal cost is usually not treated as directly observable in this work; the X_i usually include input prices. The quasi-supply relations are often estimated with the industry inverse demand relation, $P = P(Q,Z)$, and sometimes also with total cost or input demand functions. Identification of the λ's may rest on the availability of exogenous variables in Z that change the slope of the demand curve (Lau (1982)), or on information about marginal cost or its determinants (Iwata (1974), Panzar and Rosse (1987)).

Some studies in this literature have test alternative models of conduct, such as competition and collusion (Bresnahan (1987)); others examine differences in conjectural variations over time or among firms (Geroski, Ulph, and Ulph (1986)). Still others develop alternative

approaches to the detection of non-competitive behavior in particular settings (Baker and Bresnahan (1985), Panzar and Rosse (1987)).

Laboratory Experiments Given the difficulty of obtaining detailed data on an informative set of natural market experiments, a good deal of interest has recently attached to the use of laboratory experiments to test industrial economic hypotheses (Plott (1982), Smith (1982)). Many variables that are unobservable outside the laboratory (such as beliefs and marginal costs) can be fixed in experimental settings, and the sensitivity of behavior to environmental and institutional changes can be explored directly.

While the experiments reported in the literature to date have frequently been criticized as artificially simple, they generally do involve actors with financial incentives to optimize and markets of at least the same order of complexity as those studied in theoretical analyses. Developments in computer software and experimental procedures will likely make more "realistic" experiments possible. Still, laboratory research seems best suited for testing the predictive power and robustness of particular theories; it is less useful for determining the class of real markets for which particular theories are useful.

II. BUSINESS STRUCTURE AND BEHAVIOR

There are three main points of tension between the textbook model of firm behavior and organization and reality. First, it is not obvious that the managers of real firms maximize profits. Second, few long-run average cost curves seem to be either U-shaped or everywhere declining, so that the textbook models of competition and natural monopoly do not explain how the

scales of many real firms are determined. Third, the textbook model deals with single-product firms and ignores their internal structures, even though real firms produce multiple products and must decide the scopes of their activities and their internal organization. This section considers research bearing on these three points.

Managerial Behavior

There have historically been two main criticisms of the traditional assumption that firms maximize profits, properly generalized where appropriate to mean maximization of shareholders' wealth.[11] While both have force, neither has yet produced a superior alternative assumption.

Behavioral Theories The first criticism begins by noting that many decisions that managers make regularly are much harder than the simplified problems with which theorists struggle. Thus limits to human information processing capabilities -- *bounded rationality* -- make strict profit maximization fundamentally implausible. And nobody who observes real firms closely can avoid noticing managerial blunders.[12]

But, while there is evidence that managers often follow simple rules of thumb in lieu of consciously maximizing, it has proven difficult to characterize such rules at the level of generality required for a tractable model implying systematic departures from profit-maximization. Additional difficulties arise because competition acts to weed out rules of thumb that do not at least approximately maximize profit (Nelson and Winter (1982)). This evolutionary process plainly does not work instantly or perfectly in real markets, but it has proven difficult to specify its imperfections in a useful, general way.

Agency Relations The second major critique of profit-maximization, which has attracted considerably more attention in recent years, begins with the observation that most large corporations are not managed by their owners. Thus managers are likely to have objectives other than maximizing owners' wealth. Moreover, many boards of directors are dominated by managers, not owners. And, while owners can and do replace directors and managers whose performance is unsatisfactory, the mechanisms available for this purpose (takeovers and proxy fights) are hardly frictionless. Thus managers are likely to have some freedom to pursue their own objectives at owners' expense.

This critique led initially to the development of models in which managers maximized some specific personal objective, such as revenue, employees, growth, or managerial perquisites, subject to a profitability constraint imposed by product and capital markets. It is not clear what is the "correct" managerial objective, and the determinants of the crucial profitability constraint are typically left unspecified. Related empirical work has produced mixed results (Smirlock and Marshall (1983)).

More recently, the tools of agency theory have been employed to model the implications of asymmetric information when ownership and control are separated (Jensen and Meckling (1976)). The firm is viewed through the lens of agency theory as a set of contracts (some provisions of which may be fixed by law or custom) among input suppliers. These contracts are generally incomplete; they do not fully specify the consequences for all parties of all possible actions in all possible states of nature. Incompleteness may occur because of asymmetric information (e.g., about managerial effort) or because some observable variables (e.g., the riskiness

of investments) are too complex to be objectively verified by third parties, so that contract provisions involving them would be unenforceable.

Optimal contract terms are then derived under relatively specific assumptions about information and strategy sets. These contracts are then often compared informally to actual laws, customs, and institutions. Departures from profit maximization are usually treated as managerial slack or failure to provide effort, not as pursuit of alternative objectives. This research has turned up a number of theoretical phenomena discussed at more length in the next section: actions may be rationally undertaken mainly to affect others' perceptions even when the others are aware of this possibility and are not fooled, for instance. In many situations, optimal contracts cannot induce the behavior that would occur under full or symmetric information, and systematic departures from profit-maximization are predicted in a variety of settings. But few of these predictions have been tested empirically, and no tractable, general alternative to the profit-maximization assumption has yet emerged from this research.

Agency-theoretic work on the firm spills over into finance when it considers the operation of capital markets; it spills over into labor economics when it considers employment arrangements and superior/subordinate relations. The tools of agency theory have also been used to study the design of institutions or mechanisms for regulating natural monopolies or supervising public enterprises under asymmetric information. Many models have been analyzed, and prescriptions seem sensitive to details of the assumed information structures. Beyond the result that "cost plus" regulatory (or other) contracts are rarely optimal, little in the way of operational policy guidance has yet emerged from this work (Joskow and

Schmalensee (1986)). Similarly, no terribly strong arguments for privatization of government-owned natural monopolies have been developed (Vickers and Yarrow (1988)).

Conglomerate Mergers An interesting set of issues broadly related to the separation of ownership and control has been raised by the wave of *conglomerate mergers* and acquisitions -- combinations of firms that are not participants in the same product markets -- in the U.S. in the 1980's. Shareholders of acquired firms seem generally to benefit from the announcement of these events, and acquiring firms' shareholders do not suffer visible losses (Jensen and Ruback (1983)). This favorable *ex ante* verdict from the stock market has been interpreted as implying that mergers on balance enhance efficiency, often by replacing inept management.

But studies of actual post-merger performance paint a rather different picture. Numerous studies in the U.K. and the U.S. have found post-merger declines in productivity, profitability, market share, and even stock prices (Cowling, *et al* (1980), Ravenscraft and Scherer (1988)). It is unclear why *ex ante* and *ex post* evaluations of mergers point in such different directions, though the latter suggest the possibility that at least some mergers serve managers better than shareholders in the long run.

Scale and Concentration

Most work on the determinants of firms' scales has been motivated by a desire to understand how *seller concentration* is determined.[13] Common measures of seller concentration increase as the number of sellers declines and as their shares become less equal; each thus gives an industry's location on some line between competitive and monopoly structures. Measures

of this sort include the four-firm concentration ratio, the share of output accounted for by the four largest sellers, and the Herfindahl-Hirschman H index, the sum of all sellers' squared market shares. These and other plausible concentration measures are highly (but not perfectly) correlated, and they tend to change slowly over time.

It seems clear that firms' scales -- and thus market concentration -- reflect what Scherer (1980, ch. 1) has termed *basic conditions* of technology and demand as well as business decisions and historical accidents. Concentration is thus endogenous in the long run.

Economies of Scale Rank correlations of manufacturing industries' concentration levels between industrialized nations are very high (Pryor (1972)), suggesting that some important common factor is at work. Technology is the most obvious candidate. Industrial economists have traditionally devoted considerable attention to the hypothesis that the more important are *economies of scale* in any particular industry, the higher will be seller concentration in that industry, all else equal.

Empirically, long-run average cost (LAC) curves seem generally to be L-shaped: at small scales average cost declines with increases in output, but average cost is approximately constant for output rates above some minimum efficient scale (MES). The importance of scale economies is typically measured by the ratio of MES to the total capacity or output of the industry, sometimes augmented by a measure of the steepness of the LAC curve at scales below MES.

Estimates of MES have been obtained by interviewing engineers and executives, by studying the variation of cost or profitability with scale, by seeing what sizes of plants or firms seem to prosper, and by assuming

that some fraction (usually half) of an industry's output is produced in efficient plants either in the country of interest or in some larger country (typically the U.S.). Estimates based on real data inevitably reflect competitive conditions and historical investment patterns, along with the characteristics of best-practice technology that are of primary interest. Answers given in interviews may be speculative when questions go beyond the design decisions with which interviewees are familiar: many people design plants, but few design firms.

Despite these measurement problems, a large number of studies have found significant positive relations between seller concentration and the market share of a MES plant or (in only a few studies) firm. But the leading firms in many U.S. markets are apparently much larger than MES, so that concentration is higher than is strictly required for production efficiency (Scherer (1980, ch. 4)). (In smaller national markets the opposite problem is often encountered, particularly where high tariff barriers are present.) A related finding is that the expected negative relation between market growth and changes in concentration tends to be weak. Similarly, among large industrialized nations, concentration levels do not decline much with increases in the size of the economy (Pryor (1972)). The sizes of leading firms tend to increase with the size of the national market, in part through increases in the extent of multi-plant operations (Scherer, Beckstein, Kaufer, and Murphy (1975)).

Learning by Doing Since it was noticed during World War II that the labor required to build particular types of ships and aircraft declined with the cumulative volume of production, similar *learning economies* have been observed in a wide variety of settings. But only a few empirical studies

have analyzed variations in the importance of learning in particular processes (Lieberman (1984)). Even less work has been done on variations in the extent to which the benefits of one firm's learning spill over to other firms or lower the costs of other products produced by the same firm.

Confining himself to the case, stressed in the business strategy literature, in which learning spillovers are completely absent, Spence (1981) explored the analogy between learning economies and economies of scale. Holding constant the ultimate total cost decline that learning can produce, Spence argued that learning would affect concentration most like economies of scale when learning economies are exhausted at "moderate" values of cumulative output. If exhaustion occurs at "low" cumulative output, a new firm needs essentially to incur only a small fixed cost to fully exploit economies of learning. At the other extreme, if full exploitation of learning economies requires "large" cumulative output, large differences in cumulative production imply only small cost differences. Unfortunately, I know of no empirical studies of the impact of learning economies on market structure.

Other Forces If LAC curves are indeed approximately flat above MES, apparently "excessive" concentration is not surprising. Relative sizes of firms that have attained MES might well change because of apparently random innovations in production and marketing, with "better" firms growing at the expense of their rivals (Demsetz (1973)). Any particular innovation might tend to increase or decrease concentration, depending on whether it was made by a relatively large or relatively small firm. As this reasoning would suggest, U.S. manufacturing industries that experience large increases or decreases in concentration tend to show above-average increases in

productivity and below-average increases in price (Gisser (1984)). A variety of stochastic processes that might plausibly summarize this mechanism tend over time to produce skewed firm size distributions with considerable inequality in firm sizes, broadly consistent with the facts in most U.S. and U.K. industries.[14] Similarly, concentration can be maintained or increased by strategic behavior aimed at deterring entry or disadvantaging small rivals.

Another process leading to "excessive" concentration is *horizontal mergers* -- combinations of competitors. The importance of this process has been vigorously debated, particularly in the U.K. (Curry and George (1983)). On balance, mergers seem to have been important sources of concentration in some E.E.C. nations, but not in the U.S., where policy toward horizontal mergers was quite strict from the early 1950's until the Reagan years. Shareholders of rival firms tend to gain from major horizontal mergers, as the frequently-hypothesized relation between concentration and monopolistic behavior implies, but the size of the gain appears unrelated to the level of concentration (Eckbo (1985)). On the other hand, some horizontal mergers do seem to raise prices (Barton and Sherman (1984)).

Scope and Organization

When firms produce multiple products, as virtually all real firms do, long-run cost functions cannot be described solely in terms of single-product economies of scale. Indeed in the multi-product context, product-specific average costs are not in general well-defined, and the definitions of economies of scale and natural monopoly must be significantly generalized (Baumol, Panzar, and Willig (1982)). Moreover, it seems clear that the

boundaries between firms and markets and the internal organization of business firms is not determined only by the technology of production; the technology of transaction governance and supervision also matters.

Economies of Scope One of the more useful concepts that emerges from recent work on multi-product cost and production functions is *economies of scope*, which are present when total cost can be reduced by consolidating production of multiple products within a single enterprise. Roughly, economies of scope arise if (but not only if) there are scale economies in the provision of services used to produce more than one output: the same switch can be used for both local and long-distance telephone service, for instance, or the same trucks can be used to deliver a wide array of products to grocery stores. One would expect firms to design product lines to exploit important scope economies, just as one would expect generally to observe firms large enough to exploit important economies of scale. But, while a number of authors have estimated multi-product cost functions, serious empirical use of multi-product cost concepts is not common.

Transaction Governance The agency theory view of the firm is complementary to a line of research based on the argument that under competitive conditions, economic activity will be organized so as to economize on production costs plus *transactions costs* (Williamson (1985)). The many forms of transaction governance observed in practice can be thought of as forming a continuum, with classic spot markets and internal governance within firms at the extremes and contracts of varying duration and complexity in between.

Work on transactions costs has concentrated on the identification of transaction attributes that generally affect the comparative performance of

alternative governance structures in a world of selfish, boundedly rational actors, asymmetric information, and incomplete contracts. The transaction attribute most stressed in recent work has been *asset specificity*, the extent to which a particular transaction requires tangible or intangible assets that would be of substantially less value if redeployed to alternative transactions. Asset specificity is closely related to the notion of *sunk costs*, costs that could not be recovered if a particular activity were abandoned. The costs of digging a coal mine are sunk, for instance, since they would be lost if the coal business were abandoned. But no asset specificity is involved if a coal mine can easily sell on a spot market to many alternative customers. On the other hand, if an electric generating plant is built at the mouth of a coal mine, asset specificity is important, since the value of both the mine and the plant would decline if the mine had to sell its coal elsewhere and the generating plant had to ship in its coal from other mines.

The general argument is that when asset specificity is important, contractual incompleteness inevitably puts at least one party to the transaction at considerable risk, since the value of his investment would decline substantially if the transaction broke down. Even if *ex ante* many firms compete to dig a coal mine next to some particular power plant, *ex post*, after one firm has dug a mine, there is bilateral monopoly for the remainder of the life of the transaction. High degrees of asset specificity are predicted to lead to complex long-term contracts or internal governance within firms. This and related predictions from this framework are difficult to test because it is not clear, for instance, how asset

specificity can be routinely quantified. Still, a fair number of empirical studies have produced supportive results (Joskow (1987)).

Internal Organization Depending on the technology of supervising employees, individually and in groups, and on a particular firm's market environment(s) and long-run strategy, different internal structures may be optimal. Considerable research, much of it outside the usual boundaries of economics, has been done on the determinants and effects firms' internal structures (Caves (1980)). This work seems to have shown, among other things, that both the rise of middle management around the turn of the century (Chandler (1977)) and the more recent shift toward organizations based on multiple, relatively independent operating divisions (Williamson (1985)) reflected organizational innovations of considerable value under a fairly broad range of market and strategic conditions.

Vertical Relations Two closely related lines of work have focused on vertical integration decisions and on contractual arrangements between manufacturers and firms providing wholesale and retail distribution services. This work has been motivated in large measure by the traditional hostility of antitrust authorities toward *vertical mergers* -- combinations of a buyer and a seller -- and toward a set of contractual provisions that are called *vertical restraints* in the U.S.. These provisions limit a distributor's freedom to compete -- for instance by specifying prices to be charged at retail.

Much of the literature on vertical integration employs the agency theory or transactions costs framework and thus focuses on sources of efficiency gains. But vertical integration may also be a response to or source of competitive imperfections. A number of early authors argued that

industry-wide vertical integration that eliminated an intermediate product market could make entry more difficult by requiring an entrant to both produce and consume that product. Vertical integration may be profitable but have at best ambiguous welfare effects if it permits a monopoly manufacturer to price discriminate or to avoid downstream substitution away from its output in production, or if it arises as a response to rationing caused by price rigidities (Carlton (1979)). Very little empirical work has been devoted to integration related to market imperfections, however.

Because vertical restraints typically limit retail competition, antitrust authorities have historically viewed them as signs of retailer cartels. But it is now clear that individual manufacturers can sometimes use vertical restraints to compete more effectively. For instance, a manufacturer might want to fix retail markups in order to induce all retailers to compete by providing demand-enhancing services from which all would benefit (Telser (1960)). Alternatively, placing floors on retail prices might allow high-cost "prestige" stores to stock the product, and thereby to provide a quality signal to buyers, by removing the threat of price competition from low-cost discounters. But when competition is imperfect at manufacturer or retailer levels, the net welfare effect of privately-profitable vertical restraints is often ambiguous (Rey and Tirole (1986)), in part because they change the nature and intensity of rivalry among manufacturers or retailers. The limited empirical work that has been done in this area (primarily case studies) suggests that vertical restraints serve a wide variety of purposes and that they rarely reflect retailer cartels. But generally ambiguous welfare analyses make it hard to make strong policy prescriptions.

III. PRICE, OUTPUT, AND PROFITABILITY

A central problem of industrial economics since its emergence as a distinct field has been to devise techniques for using observable variables (*market structure*, broadly defined) to predict *conduct* in and *performance* of markets that do not meet the strict structural conditions of perfect competition. This Section and the next review work on this problem, which is made difficult because, as we saw above in the case of concentration and will discuss further below, market structures are themselves endogenously determined. The focus here is on choices of price, output, and capacity; non-price rivalry is considered in Section IV.

I begin with research on the exercise of *monopoly power* or, equivalently, *market power*. It is useful here and in what follows to distinguish between short-run and long-run market power. Short-run market power is the ability to raise price profitably above marginal cost; it arises whenever firms face downward-sloping demand curves. Long-run market power is the ability to earn persistently supra-normal profits by setting price above average cost. In the textbook tangency equilibrium of Chamberlinian monopolistic competition, for instance, firms have short-run market power but no long-run market power.

Most work on the exercise of market power employs variants of the standard monopoly model. In an industry with more than one firm, sellers' profits depend on the intensity of rivalry and, in the long run, on the entry of new firms. The next two subsections review theoretical work on these dimensions of behavior. The final two subsections consider related empirical work on market conduct and performance.

The Exercise of Monopoly Power

Price Discrimination A common symptom of monopoly power is *price discrimination*, which can be roughly defined as selling units of related goods at different percentage markups over marginal cost (Phlips (1983)). In order to discriminate profitably, a firm must be able to affect the prices it receives for its output, to sort units potentially demanded according to their optimal prices, and to avoid arbitrage. The first of these conditions is satisfied whenever firms have short-run monopoly power; price discrimination is consistent with free-entry, zero-profit equilibria involving no long-run power. The monopoly models that dominate this literature are thus potentially components of models of discrimination under other market structures.

Following Pigou, it is useful to consider three basic types of price discrimination. A monopolist practicing first-degree or perfect discrimination leaves all her customers just indifferent between buying and not buying. Unlike a non-discriminating monopolist, she does not restrict output. Instead, she maximizes total surplus, as under competition, and then appropriates it all. It does not follow that real price discrimination is generally efficiency-enhancing, however, since first-degree discrimination is a limiting case found only in texts and journals.

The simplest of Pigou's other two types is third degree discrimination, which involves sorting customers into groups according to their demand elasticities and charging group-specific prices that vary inversely with elasticity. Case studies provide a rich array of sorting mechanisms: discounts for air travelers who reserve far in advance sort tourists from

business travelers, for instance, and supermarket coupons are used only by price-sensitive consumers. In these and other cases, transactions costs seem to be the main check on arbitrage.

Since price discrimination makes marginal rates of substitution unequal, an increase in total output is a necessary condition for third-degree discrimination to increase (Marshallian) social welfare (Varian (1985)). Output is unaffected by discrimination if all group demands are linear *and* all groups make purchases under both uniform and discriminatory pricing; total output is more likely to increase if sales to some groups are profitable only under discrimination. Ambiguous welfare results of this sort make it hard to prescribe general policies toward price discrimination.

The final Pigouvian type, second-degree discrimination, involves *nonlinear pricing*, in which the buyer's average cost per unit depends on the quantity purchased (Maskin and Riley (1984)). The simplest case of non-linear pricing is the so-called two-part tariff: buyers must pay a fixed charge, F, for the right to purchase any amount at a per-unit cost of P. If individual demand curves do not cross, profits are maximized with F positive and P between marginal cost and the ordinary monopoly price (Oi (1971)). Intuitively, it pays a monopoly to reduce P a bit if it can capture some of the increased consumer's surplus by raising F. If there are a finite number of consumer types with non-crossing demand curves, then under general nonlinear pricing regimes with a finite number of consumer types, all types but the one with the largest demand have marginal valuations for the good that exceed marginal cost, and all types but the one with the smallest demand enjoy positive consumer's surplus. Under some conditions the optimal

nonlinear price schedule can be implemented by allowing buyers to select from a set of two-part tariffs.

Actual pricing decisions and theoretical studies often involve variations on and combinations of the last two Pigouvian themes. An extensive literature has developed on spatial price discrimination. Random variations in price over time or space may profitably sort buyers according to their costs of search. Multi-product monopolies must consider cross-price elasticities and may find it profitable to sell bundles of two or more products or to use nonlinear pricing (Spence (1980)). Finally, one might think that a monopolist selling a durable good could discriminate intertemporally by lowering price over time, thus effecting first-degree discrimination by sweeping out the demand curve. But sophisticated buyers will anticipate price cuts under these conditions and will postpone their purchases until price falls to marginal cost, so that the monopolist would actually be better off if he could commit never to change price (Gul, Sonnenschein, and Wilson (1986)).

A number of authors have studied the problem of pricing to maximize the welfare generated by a natural monopoly that is subject to a break-even constraint. This research, which has had a significant impact on public utility pricing, is closely related to work on optimal commodity taxation. Since price discrimination is generally profit-maximizing, profit-constrained welfare maximization generally involves departures from marginal-cost pricing in the direction of discriminating monopoly pricing. The use of nonlinear pricing is often particularly attractive in this setting, since it can Pareto-dominate linear pricing (Willig (1978)).

Non-Price Consequences Spence (1975) showed that a single-product monopoly could choose a sub-optimal or supra-optimal quality level depending on the details of the demand structure. In order to maximize profit, a monopoly considers the effect of quality only on the reservation price of the marginal consumer, who is indifferent between purchasing and not, rather than on the value of the product to the average consumer. For basically the same reason, multi-product monopolies may offer too much or too little variety. If consumers differ in their willingness to pay for increments to quality, a multi-product monopolist will generally increase quality differences above socially optimal levels (under standard assumptions by lowering qualities at the low end of the product line) in order to facilitate price discrimination.

Oligopoly Theory

The Holy Grail of research in oligopoly theory has been the ability to use observable quantities to predict the intensity of rivalry in markets dominated by a small number of sellers. The literature now contains dozens of formal oligopoly models. These have provided insights that can be used to structure the analysis of particular markets, but they have given us a multitude of possibilities rather than the Holy Grail. Indeed, collectively they suggest that the Grail may not exist.

Cournot vs. Bertrand This point is illustrated by two important oligopoly models that were introduced well before the emergence of industrial economics as a distinct field: the one-period Cournot (output-setting) and Bertrand (price-setting) models. When products are homogeneous, the former predicts behavior intermediate between competition

and monopoly with any finite number of sellers, with competition generally emerging in the limit as the number of sellers grows. Multiplying each of equations (2) by q_i, adding, and rearranging, we obtain

$$(P - \overline{MC})/P = H/E, \tag{4}$$

where E is the market price elasticity of demand, $-P/P'(Q)Q$, H is the sum of squared market shares, $\Sigma(q_i/Q)^2$, and $\overline{MC}$ is average marginal cost, $\Sigma q_i MC_i/Q$. If all N firms have the same cost functions, $H = 1/N$, and the gap between price and marginal cost declines smoothly from the monopoly level to zero as N rises.

The Bertrand model, in contrast, predicts essentially competitive outcomes with two or more sellers when products are homogeneous. If all sellers have the same cost functions and there are no capacity constraints, no pure strategy equilibrium with prices above marginal cost can exist, since any seller could increase profits by undercutting the lowest price slightly and capturing the entire market. Even when products are differentiated, outcomes tend to be noticeably more competitive when price is the strategic variable than when quantities are chosen. Intuitively, any single seller's demand curve has roughly the slope of the market curve when rivals' quantities are fixed; its demand curve is much flatter when it can steal sales from rivals by undercutting their fixed prices.

Neither of these classic models is fully satisfactory. The mechanics of price determination are unclear in the Cournot model, while the Bertrand model depends on the absence of capacity constraints. A natural way to unify them is by observing that prices are generally more easily adjusted than capacities and considering a two-period game with capacities chosen in

the first period and prices chosen in the second. Unfortunately, the equilibria of this game may either be Cournot or substantially more competitive, depending on how excess demand (which is never observed in equilibrium) is assumed to be rationed (Davidson and Deneckere (1986)).

Two-period games of this sort, in which irreversible first-period commitments are made with a view to affecting second-period play, provide a useful approach to modelling a wide variety of situations. By signing contracts binding themselves to matching the lowest price offered by another firm, for instance, or engaging in a variety of related "facilitating practices," sellers may be able to support collusive outcomes (Salop (1986)). The observation that government policies (such as export subsidies) may serve as valuable commitments to firms in open economies has led to a fundamental reexamination of the case for free trade (Brander and Spencer (1985), Krugman (1986)).

Fudenberg and Tirole (1984) have shown that the qualitative nature of first-period strategies in two-period games of this sort depends simply on the signs of two second-order partial derivatives of firms' payoff functions. (See also Bulow, Geanakoplos, and Klemperer (1985).) In particular, first-period strategies generally depend critically on whether the second-period game is of the Bertrand or the Cournot type. While in Cournot models a firm's best response to an aggressive increase in its rivals' output is generally to retreat by reducing its own output, in a Bertrand model (with differentiated products) the best response to an aggressive price reduction is usually to counterattack by cutting price.

Supergames and Collusion In an influential paper, Stigler (1964) argued that oligopoly theory should be based on the theory of cartels. Any

cartel has two tasks (Scherer (1980, ch. 5-7)). Its first task is to agree on a course of action -- a set of firm-specific outputs, for instance. Agreement is likely to be more difficult the more sellers that must be involved and the greater the differences among their costs and products. Stigler and most subsequent authors have placed more stress on the second task: to deter violations of the cartel agreement. When prices are raised to monopoly levels, each seller stands to gain by making undetected price cuts or output increases. Such cheating is less attractive the more quickly it can be detected and the more severe the punishment that can be credibly threatened. Cartel members may facilitate detection by dividing customers among themselves or adopting a number of related practices. Stigler noted that these same two problems must be solved by firms that attempt *tacit collusion*, on which the subsequent literature has concentrated, and try to mimic the explicit or overt collusion of a cartel without a formal agreement.

Because detection and punishment take time, the supergame framework has often been employed to study the stability of collusive agreements, most often with variants of the Cournot model as the stage game. But with full information, collusion cannot emerge as a perfect equilibrium when the number of periods is finite and known in advance. To see why, suppose the stage game is Cournot. In the last period, firms face a one-period Cournot game, and the outcome must be the Cournot solution. Threats to behave otherwise are not credible. But since nothing done in the second-last period can affect what happens in the last period (beliefs are fixed with full information), the firms face a one-period Cournot game at the start of the second-last period as well. By backward induction, rational players

will simply repeat their one-period Cournot strategies whenever there is a known, finite last period.

Thus collusive equilibria can only appear when the horizon is infinite. But in this case the Folk Theorem comes into play: in a large class of models there seem almost always to exist *many* collusive perfect equilibria, in which average payoffs exceed those in the stage game equilibrium. Suppose, for instance, that the basic Cournot game discussed in Section I is to be played an infinite number of times and that $MC_i(q_i) = M$, a constant for all firms. Then the single-period monopoly output, Q^m, is well-defined. Let q^c be the single-firm Cournot output obtained by solving equations (2). Suppose each firm's strategy is to produce $q^m = Q^m/N$ in period 1 and in every later period in which the previous period's total output has been Q^m, and to produce q^c otherwise. If all other firms play this strategy, firm i could increase its profits in any single period by increasing its output. But in all subsequent periods it would then earn only Cournot, not monopoly profits. (If all other firms will produce q^c, firm i's best response, by definition, is to produce q^c also.) If the discount rate is low enough, the present value of these future losses will exceed the single-period gains from cheating, and the strategies discussed above will form a Nash equilibrium in which the monopoly output is produced in all periods.

Of course, as Stigler stressed, firms may not be able to observe each others' outputs directly. But even if players can only observe market price, which depends on industry output and a random variable, there generally exists a continuum of collusive equilibria supported by *trigger price* strategies for any finite number of sellers (Green and Porter (1984)). These involve producing a low (collusive or monopoly) output unless market

price drops below some level, and then (assuming symmetry) producing q^c for some punishment period. (This threat is credible, as above, since if everyone expects everyone else to produce q^c, the best response is to follow suit.) In these equilibria cheating never occurs, but punishments are nonetheless sometimes carried out.

This literature shows clearly that the more damaging the threats that can be credibly made and the smaller the gains from cheating, the greater the scope for profitable collusion (Abreu (1986)). Thus, somewhat paradoxically, the best sustainable collusive outcomes may be more monopolistic when the stage game is Bertrand than when it is Cournot, since the single-period Bertrand equilibrium involves zero profits, and excess capacity that can be used to fight price wars may instead sustain monopoly prices. Collusion may be more effective at business cycle troughs than at peaks if cheating is more profitable when demand is strong (Rotemberg and Saloner (1986)).

The supergame literature raises some serious questions that have not yet been completely answered. In the absence of explicit collusion, how can firms select a single equilibrium from a continuum -- particularly if (as in reality) the firms are not identical? What are we to make of the fact that collusive equilibria generally exist for reasonable numbers of firms -- is collusion really almost universal? Is it plausible to think that cheating on collusive understandings never occurs? What happens if firms can renegotiate collusive agreements during a punishment period (Farrell and Maskin (1987))? The supergame literature seems so far mainly to have added to the long list of possible behavior patterns developed in

other branches of oligopoly theory, not to have placed strong restrictions on observable conduct.

Entry and Exclusion

Bain (1956) defined *barriers to entry* as factors that make it possible for established firms in an industry to enjoy supra-normal profits without attracting new entry.[15] Without entry barriers, there can be no long-run market power; collusive behavior cannot succeed in raising profits in the long run. Thus preventing the entry of new firms is roughly as important in the long run as restraining rivalry among established sellers. Bain listed four sources of entry barriers: economies of scale, cost advantages of established firms, product differentiation advantages of established firms, and absolute capital costs. This list has generated both controversy and research on the possible exploitation of these factors to deter entry or induce exit. Recent work here, as in other areas, has paid particular attention to the implications of asymmetric information.

Scale Economies In the presence of economies of scale, a viable entrant would add a non-negligible amount to total industry output. Bain (1956) argued a monopolist would engage in *limit pricing* to deter entry in this case by setting pre-entry output high enough (generally above the ordinary monopoly level) so that the addition of an entrant's output would force price below cost. But this argument has a serious game-theoretic problem: the implicit threat to maintain output in response to entry is not credible, since the incumbent (quantity-setting) firm would generally do better to reduce production.

Spence (1977) observed that an incumbent's irreversible pre-entry investment in capacity might make threats of this sort credible by lowering its post-entry marginal cost, thus enhancing its incentives to maintain high output. (See also Dixit (1979).) Similarly, learning economies may induce an established firm to increase its pre-entry output in order to lower its post-entry marginal cost. In a variety of two-period models, an established monopoly over-invests in the first period to deter entry.[16] Pre-entry output generally exceeds the monopoly level, as in limit-pricing, and profit may be much lower unless scale economies are very important (Schmalensee (1981)). The welfare implications of this behavior are generally ambiguous, since entry tends to be socially excessive in the presence of economies of scale (Mankiw and Whinston (1986)).

The effects of scale economies also depend critically on timing assumptions and on the importance of sunk costs. In the limiting case of a *perfectly contestable* market there are no sunk costs, so that firms can enter or exit an industry costlessly, and entrants can enter, undercut incumbents' prices, and exit before incumbents can react. Under these strong assumptions about costs and differential reaction lags, and with other sources of entry barriers assumed away, potential entrants can enforce essentially competitive outcomes even in natural monopolies (Baumol, Panzar, and Willig (1982)). More generally, the higher are sunk costs, the greater the risk assumed by entrants, and thus the less attractive is entry. Thus *barriers to exit*, tangible and intangible sunk costs that make exit unattractive even when economic profits are negative, also serve to discourage entry.

In some markets scale economies imply that capacity is most economically added in large lumps, and investment costs are mostly sunk. Under these circumstances entry may be rationally prevented by *preemption*, the seizing of a discrete opportunity by an incumbent firm with market power before it can be used by an outsider to enter. The value of a new plant to an incumbent monopolist in a growing market is the difference between the monopoly profit it would enjoy with the plant and its share of the duopoly profit that it would receive if the potential entrant built the plant and entered. The value to the entrant is its share of duopoly profit in the latter case. As long as monopoly profit exceeds total duopoly profit, the plant will be worth more to the incumbent -- who will thus have an incentive to build it before the market has grown enough to attract an entrant.

Other Bainian Barriers The effects of incumbents' cost advantages on entry incentives is sensitive to assumptions regarding post-entry rivalry.[17] If the post-entry game would be Bertrand (with simultaneous moves) even a tiny cost advantage of an established monopoly serves to deter entry. But in the Cournot case, entry may be profitable despite higher costs. Indeed, with linear demand and constant costs, it is easy to show that high-cost but profitable entry may lower total surplus in the latter case.

Switching costs may be important sources of product differentiation advantages of established firms in some markets. Switching costs may be objective, as in the case of computer systems, or subjective, deriving from a satisfied customer's rational reluctance to experiment with an untried entrant (Schmalensee (1982)). While it seems clear that these costs can advantage early entrants, the critical role of expectations in buyers' decisions makes multi-period modelling difficult outside steady states.

Bain's argument that an entrant's need to invest absolutely large sums of money might serve as a barrier to entry has been widely criticized because it seems to rest on capital market imperfections; incumbents also had to invest large sums. Bain might have been groping toward the sunk cost issues discussed above. Or, he might have anticipated the point that even perfectly competitive capital markets may be seriously affected by asymmetric information regarding a potential entrant's prospects.

Information and Reputation Information asymmetries can rationalize a variety of policies to deter entry or induce exit (Roberts (1987)). If its costs are unobservable, an established monopolist may set price below the monopoly level, as in earlier limit-pricing models, in order to signal to potential entrants that its costs are lower than theirs would likely be. On the other hand, if potential entrants know only that their post-entry costs would be similar to those of an incumbent monopolist, the latter may set price *above* the monopoly level in order to signal that its costs are high and the market is thus relatively unattractive (Harrington (1986). Of course, since rational actors understand opponents' incentives perfectly and probability distributions of cost levels are common knowledge, nobody is fooled on average in equilibrium in either case.

Imperfect information can also provide a rationale for *predatory pricing*, a legal term of art generally taken to mean charging unprofitably low prices in order to eliminate an established rival.[18] Until relatively recently, the following points were taken as a proof that predatory pricing is rarely if ever rational. The predator's losses generally exceed the prey's, since the prey can shut down temporarily, while the predator must make substantial sales to keep price low. Even if the prey is driven into

bankruptcy, the predator may need acquire the prey's assets in order to avoid their being operated by a new rival. But then it will surely be cheaper simply to merge with the prey at the outset than to incur losses driving it from the market.

A number of recent studies have argued that potential entrants might well attach some positive probability (assumed of course to be common knowledge) to the possibility that an established monopoly is irrational -- that it will always prey on entrants regardless of the costs. Then a rational established firm facing a finite set of potential entrants will often find it optimal to prey on the first few entrants in order to build (or, more precisely, to avoid destroying) a useful *reputation* for irrationality (Kreps and Wilson (1982)). With incomplete information, predation may also serve to lower the cost to the predator of acquiring the prey (Saloner (1987)). Unfortunately, since unobservable beliefs play a critical role in reputation models, these models place relatively weak restrictions on observed behavior; they imply the potential rationality of predation under almost any observable conditions.

Does Market Structure Matter?

Let us now turn to empirical research.[19] Many of the industry case studies discussed in Section seemed to detect tacitly collusive patterns of behavior in a variety of concentrated markets. But later, more quantitative studies have produced less clear-cut evidence of market power.

Profitability Differences Oligopoly theory suggests at least the plausibility of the hypothesis that there is a negative relation between seller concentration and the average intensity of rivalry. Bain (1951)

argued that this implies that concentration should be positively correlated with industry-average profitability, and he found some support for such a correlation. Literally hundreds of subsequent studies have examined the relation between concentration and profitability in cross-section data.

Through the early 1970's, most such studies found a weak, positive correlation between concentration and industry-average profitability. The weakness of this relation was generally attributed to problems of defining markets and measuring profitability, and these results were generally interpreted as confirming the hypothesis that concentration tends to facilitate collusion and otherwise limit rivalry.

Then Demsetz (1973) provided a plausible and disturbing alternative interpretation. To illustrate his argument, suppose that the single-period Cournot model developed above describes price formation in all markets, regardless of the level of concentration. Since cross-section regressions aim to reveal differences in long-run equilibria, suppose further that all production takes place under constant returns to scale (all firms are above MES) but that costs may differ within individual markets. Then equation (4) implies that for any individual industry,

$$\Pi/(PQ) = H/E, \tag{5}$$

where $\Pi/(PQ)$ is the industry's rate of return on sales.[20] For any value of N, H will be larger the greater the variance in firms' costs.

This model thus predicts that in industries in which all firms are roughly equally efficient, concentration and industry-average profitability will be low. In industries in which some firms are noticeably more efficient than others, the more efficient firms will tend to capture large

market shares, so that concentration will be high. And more efficient firms will earn rents, so that industry-average profits will also be high. Thus concentration and industry-average profitability will be positively correlated even though there is no collusion anywhere.

This formal model probably overstates the dependence of concentration on idiosyncratic cost differences in light of the high correlations between concentration levels in different nations. But Demsetz's basic argument has received some empirical support. Bain's (1951, p. 320) did note that in his data, "Smaller firms tended to fare about the same regardless of industry concentration; the dominant firms in general had earnings rates that were positively influenced by concentration," and other U.S. studies have confirmed this finding. Similarly, at the firm or business unit level, market share is strongly correlated with profitability in samples that include many industries, and the coefficient of concentration is negative or insignificant in profitability regressions including market share (Ravenscraft (1983)). On the other hand profitability is not strongly related to market share in a sizeable fraction of manufacturing industries, (Porter (1979)). A variety of attempts to discriminate between the Bain and Demsetz interpretations have produced mixed results -- suggesting at least that both mechanisms may be at work in the economy.

The 1970's also saw the publication of a host of industry-level studies in which the concentration-profitability correlation was zero or negative. In U.S. data this correlation weakened dramatically in that decade (Domowitz, Hubbard, and Petersen (1986)); U.K. data seem to yield a monotonic relation between concentration and profitability very reluctantly (Geroski (1981)). Thus not only is it now hard to interpret a significant

positive correlation between concentration and profitability, it is hard to find such a correlation in many data sets.[21]

Bain (1956) noted that collusion could not sustain high profits in the long run in the absence of barriers to entry. This calls for an interactive (concentration × barriers) specification, but such specifications have not fared well empirically, perhaps in part because it is difficult to measure barriers to entry empirically. The most robust interactive result of this general sort is that the impact of imports on domestic profitability seems to be higher when domestic concentration is high (Caves (1985)).

A sizeable number of authors have simply added proxies for various sources of entry barriers to regressions of profitability on concentration. In these linear (concentration + barriers) specifications, measures of scale economies or capital requirements of entry tend to be positively related to profitability, as do measures of advertising intensity. (The interpretation of the advertising results is discussed in Section IV.)

In Bain's (1951) data, if one takes average profitability in the unconcentrated subsample to be the competitive rate of return, it follows that monopoly profits in the concentrated subsample average less than 5% of sales.[22] Indeed, even ignoring concentration, observed profitability differences, which are magnified by short-run disequilibria, are generally small relative to those implied by theoretical comparisons between competition and monopoly.[23] For this reason, studies of the total social cost of market power based on observed profitability differences tend to produce tiny deadweight loss estimates.

Industry-Specific and Behavioral Evidence Inter-industry profitability studies suffer from the limitations of accounting data and the inability to

measure a host of industry-specific variables. A number of authors have dealt with these problems by examining the correlation between seller concentration and the level of price across markets (often geographically separated) within individual industries. Most find a significant positive relation (Branman, Klein, and Weiss (1987)), tending to support an association between concentration and restrained rivalry. And there is some evidence that prices, like profits, are raised by tariff protection of concentrated industries. But few price studies attempt to investigate systematically the effects of conditions of entry.

The wave of econometric industry studies that have appeared in recent years generally conclude that firms set price above marginal cost (Cubbin (1975), Bresnahan (1987)). Estimates of λ_i in equations like (3) always exceed (-1) and seem to be positive more often than negative. The data necessary for these studies are most readily available for concentrated industries, particularly those that have been subjected to antitrust prosecution, many of which sell differentiated products, and many different techniques that have been employed in this work. Thus very little has been learned from econometric industry studies about general relations between market conduct and observable elements of market structure. But this work does suggest strongly that short-run market power is exercised in at least some concentrated industries.

The experimental literature mirrors recent theoretical findings: behavior in laboratory markets seems sensitive to small changes in information and institutional structures (Plott (1982)). In both large-numbers and monopoly situations, the cases that have received the most attention in this literature, performance seems to vary considerably

depending on whether prices are posted, negotiated, or called out. A wide variety of outcomes have been observed in broadly similar experimental oligopoly markets. Some practices that have been alleged to facilitate collusion (Salop (1986)) have been observed to have this effect in the laboratory (Grether and Plott (1984)).

Many market settings and hypotheses about strategic behavior have been investigated experimentally only once or twice; some parts of the theoretical literature have remained untouched by experiments. Like econometric industry studies, laboratory experiments have not yet yielded a set of robust empirical findings that can serve to replace or underlie a general formal theory of imperfect competition. But they do seem generally to support the hypothesis that (exogenous) market structure affects behavior.

Two additional bits of evidence deserve mention here. Hay and Kelley (1974) found that price-fixing conspiracies, at least those that were detected by U.S. antitrust authorities, tended to occur in concentrated industries. And Hall (1987) has argued that the assumption of short-run monopoly power provides the best explanation for the observation that productivity varies pro-cyclically in many industries.

Rent Dissipation and Rent Sharing

The preceding discussion suggests that short-run market power is not uncommon, but the high profits that would be predicted by long-run market power are rare. It would seem that either the rents produced by pricing above marginal cost are dissipated, perhaps by entry or non-price rivalry,

or they are shared by firms' owners with suppliers of other inputs. I deal here with entry and rent sharing and treat non-price rivalry in Section IV.

Entry If entry is easy, we have known since Chamberlin (and been recently reminded by contestability theory) that prices above marginal cost are consistent with zero economic profits. Official data usually show large numbers of small entrants in most industries, though most obtain tiny market shares and small new entrants have particularly high failure rates (Dunne, Roberts, and Samuelson (1987)).

One might explain away the lack of a robust positive correlation between concentration and profitability by arguing that collusive behavior tends to attract small inefficient entrants, whose performance depresses industry averages. But the fraction of output produced in inefficiently small plants seems if anything to be negatively related to concentration. On the other hand, the inefficient entry hypothesis is consistent with the finding that tariff protection increases this fraction, particularly in concentrated industries (Baldwin and Gorecki (1985)).

Alternatively, one might argue that monopoly rents are largely dissipated in the process of obtaining market power and deterring the entry of effective rivals. High estimates of the welfare cost of market power are implied by this argument (Cowling and Mueller (1978)), but the theoretical and empirical case for substantial rent dissipation of this sort is somewhat weak (Fudenberg and Tirole (1987)). In particular, little direct evidence of strategic behavior to deter entry has been detected in industry studies (Lieberman (1987)), though unfortunately few attempts have been made to detect it.

A few studies have examined correlates of measures of the importance of

entry. Estimates of the market share of a plant of minimum efficient scale and of the capital cost of such a plant tend to be negatively related to observed entry, as does advertising intensity. Profitability is not generally strongly correlated with subsequent entry, but it is unclear whether this reflects expectations that significant entry would lower profits or the difficulty of measuring profitability.

Labor Costs One might expect managerial behavior that is not in shareholders' interests to be more prevalent, *ceteris paribus*, when rivalry, and thus market discipline, is weak. And one might expect costs to rise as a consequence of such behavior, either because managers treat themselves to high salaries, plush offices, and large staffs or because they simply fail to perform the unpleasant task of cost control. There appears to be little empirical support for this view of the world (Smirlock and Marshall (1983)), but measurement problems are obviously severe.

A good deal of work has recently been done on inter-industry wage differences that cannot be explained by differences in worker characteristics (Krueger and Summers (1987)). Like market concentration, these differences seem stable over time and highly correlated internationally. A number of authors have found that after controlling for worker characteristics, wage rates tend to be high in industries with high profitability (Dickens and Katz (1987)), suggesting that monopoly rents may be largely captured by workers. Rose's (1987) before-and-after study of trucking deregulation in the U.S. indicates that unionized workers captured over 2/3 of the rents produced by regulation. On the other hand, the pattern of wage differences in the Eastern Bloc seems to be highly correlated with that in the West. For this and other reasons, the exact

roles of technology, market power, and unobservable worker characteristics in the determination of wage differences remain controversial, though the view that monopoly profits tend to be shared with workers (particularly unionized workers) is coming to be widely held.

IV. NON-PRICE RIVALRY

Despite the picture painted by most microeconomics texts, business managers do not devote all their waking hours to setting price, output, and capacity. Major changes in capacity are infrequent, and prices tend to be rigid, especially in concentrated industries (Carlton (1986)). Important decisions regarding product quality and variety, advertising, and research and development are more frequent in many market settings. These decisions in turn often have important effects on the evolution of market structures.

There is relatively little in the academic empirical literature -- or even in the folklore of antitrust -- to suggest that non-price rivalry is often much muted by collusive behavior. Perhaps this is because it is more difficult to monitor rivals' research, advertising, and design activities than their prices and because it takes longer to retaliate along these dimensions than to change prices. At any rate, the literature on non-price rivalry has been more concerned with the social efficiency of noncollusive behavior than with the possibility of collusion. Little support has been found for the notion that non-price rivalry generally dissipates rents in a socially optimal manner.

Product Selection

Competing sellers rarely choose to offer exactly identical products, since product differentiation generally makes firm demand curves less elastic and thus tends to enhance short-run market power. And product-specific fixed costs (related to design, tooling, and introductory advertising, among other things) imply that production of all possible products is rarely an optimal or equilibrium outcome in any market.

Equilibria and Optima Three types of models dominate the theoretical literature on product selection. In *representative consumer* models (Dixit and Stiglitz (1977)), there is a single buyer who consumes all products on the market and whose utility increases in the number of products available; variety is valued for its own sake. These models are consistent with Chamberlinian large-group monopolistic competition, since a change in any one product's price affects all others symmetrically. They have been used to show that intra-industry international trade, which effectively enlarges markets, can increase welfare by increasing equilibrium variety (Helpman and Krugman (1985)).

The other two types of models involve heterogenous buyers who purchase only one product and products that are described as points in a space with dimensions corresponding to product characteristics. In these models rivalry tends to be *localized* because a change in any product's price mainly affects its nearest neighbors. Thus even in markets with many firms or brands, all sellers may be effectively in small-numbers situations. In models of *horizontal differentiation* (Salop (1979)), buyers would make different choices if all possible products were available for free. The analysis of these models generally takes an explicitly spatial form; greater

variety gives buyers on average products closer to their ideal points. In contrast, *vertical differentiation* arises if buyers agree on quality comparisons among all possible products but differ in their willingness to pay for increments to quality (Shaked and Sutton (1983)).[24]

Models of all three types indicate that market equilibria rarely involve optimal arrays of products. The optimal (second-best) array would maximize consumer's plus producer's surplus (conditional on firms' pricing rules). Variety tends to be under-supplied because (absent perfect price discrimination) the profit produced by a new product is less than its contribution to total surplus. But variety tends to be over-supplied because (with multiple sellers) the profit earned on a new product generally exceeds its contribution to total industry profit, since the profit earned by rivals' existing products fall. Whether variety is under- or over-supplied on balance depends on the details of the model studied.

Entry Deterrence It has been argued that established firms may find it profitable to bar entry by preempting locations in the space of potential products (Schmalensee (1978)). The argument rests on product-specific economies of scale and basically parallels the discussion of preemption in Section III: any given product opportunity is more valuable to an established monopolist than to an entrant because entry would increase rivalry and reduce total profits from all products. But without product-specific barriers to exit the game-theoretic problem of the original limit-pricing model reappears: the threat to leave "nearby" products in place after entry may not be credible (Judd (1985)).

Empirical Studies The marketing literature contains a large set of techniques for estimation of the demand sides of markets with horizontal

and/or vertical differentiation (Shocker and Srinivasan (1979)). But these techniques have not been employed by economists. The relevant empirical literature in industrial economics is thin and concentrates on methods of econometric industry analysis when products are differentiated. For instance, Bresnahan (1987) uses a complex econometric model to test conduct hypotheses in a market with vertical differentiation. Baker and Bresnahan (1985) present a reduced form technique, which avoids the need for structural estimation of demand parameters, for estimating product-specific net demand elasticities that capture the effects of rivals' reactions to price changes. Little work has been done on testing for localized rivalry or distinguishing among alternative forms of differentiation.

Advertising

Advertising has long polarized industrial economists. Some view it as a device for differentiating products, and thus increasing market power, and for building barriers to entry. Others view advertising as a source of consumer information, which thus reduces market power, and as a means of effecting entry by informing consumers of new products. Since advertising ranges from uninformative televised skits about well-known products to newspaper ads that provide detailed price and availability information, it would not be a great surprise if both groups were sometimes right.

Theoretical Analyses A number of authors have constructed models of advertising rivalry, treating advertising outlays simply as demand shifters (Friedman (1983)). Such rivalry dissipates profits most effectively when advertising has strong effects on market shares, since then firms' advertising elasticities of demand exceed the corresponding industry

elasticity. (Recall the comparison of Bertrand and Cournot models in Section III.) Related models show how economies of scale in advertising interact with those in production to determine the net advantages of size. But to analyze the effects of advertising rivalry on welfare and conditions of entry, one must know exactly how advertising shifts demand.

If advertising alters tastes, for instance, welfare conclusions depend on which set of tastes is used to evaluate advertising-induced output changes (Dixit and Norman (1978)). And, while imperfect information is a potentially important source of market power even when there are no barriers to entry, equilibrium levels of even purely informative advertising are not generally socially optimal (Grossman and Shapiro (1984)). Under some circumstances, equilibrium advertising outlays may provide quality signals to alert consumers, since high-quality producers have the greatest incentive to have buyers sample their wares, but such signalling inevitably involves waste. Overall, the existing theoretical literature indicates that advertising equilibria are generally not welfare optima and that the nature and extent of the differences depend on the details of the model.

If advertising has long-lived effects on demand, it may be rational in a two-period model for an established firm to over-advertise in the first period to deter potential second-period entry. But optimal first-period strategies depend on exactly how advertising is assumed to affect demand and, as in any two-period model, on the type of second-period game assumed.

Evidence A number of studies have found that advertising/sales ratios in consumer goods industries first rise and then fall as concentration increases (Buxton, Davies, and Martin (1983)). While this suggests the possibility that the intensity of advertising rivalry diminishes as

concentration reaches high levels, bivariate relations between endogenous variables are inevitably difficult to interpret.

In many cross-section studies, manufacturing industry advertising intensity, typically measured by the advertising/sales ratio, is strongly correlated with accounting profitability.[25] This correlation was initially interpreted as revealing the ability of advertising outlays to differentiate products and create entry barriers. But because advertising is expensed, rather than treated as an investment, accounting profitability is generally over-stated when advertising has long-lived effects on demand. The over-statement is greater the higher is the advertising/sales ratio and the more slowly advertising effects decay (Demsetz (1979)). Similarly, if (partial) collusion produces high price-cost margins, both optimal advertising spending and profits will generally be high. The existing evidence does not definitively rule out any of these structural interpretations, in part because it is difficult to estimate the rate at which advertising effects decay or to observe exogenous determinants of advertising outlays.

A number of empirical studies suggest that the effects of advertising on market performance depend critically on the nature of the advertising involved and on the roles played by retailers and other information sources (Porter (1976)). In particular, it appears that restrictions on retailer advertising tend to raise prices (Benham (1972)).

Research and Development

It is a commonplace that technical progress, the development and use of new products and processes, is the most important source of increases in

consumer welfare in modern economies. Slight reductions in the rate of progress outweigh any plausible estimates of the static welfare costs of monopoly power after only a few years. It is also frequently noted that this subject has received much less study than its importance warrants. But, perhaps because of productivity slowdowns during the 1970's, studies of the sources of technical change have multiplied in the last few years.

Models of Technological Rivalry Theoretical work in this area has generally assumed a known, possibly stochastic relation between research and development (R&D) spending and the advance of knowledge. Most studies have considered noncooperative equilibria in which firms incur R&D costs in the hope of securing a single possible patent.[26] It is sometimes assumed (particularly when firms are asymmetric in some respect) that the firm that spends the most gets the patent. More recent work tends to assume that spending levels instead affect success probabilities; some studies assume that several successive successes are necessary to win the patent.

It has long been accepted that the market system is unlikely to yield the socially optimal rate of technical progress. The traditional view has been that there is generally too little technical progress. Unless patent protection is permanent and patent-holders can practice perfect price discrimination, the private returns to innovation will fall short of the social returns. Monopolies not threatened by entry have particularly weak incentives to innovate, since innovation in effect ends the profit flow produced by their initial monopoly position (Arrow (1962)).

But recent work that explicitly models multi-firm R&D rivalry makes it clear that there can be both too much R&D spending and too much technical progress in equilibrium (Dasgupta and Stiglitz (1980)). Duplication of R&D

efforts is a source of social waste, and intense competition for a valuable patent can lead to innovation occurring sooner than would be socially optimal. The efficiency problem here parallels that in the product selection literature; increased R&D spending by a single firm involves an externality because it lowers the expected profits of rivals. A new wrinkle is that because patents are awarded to the first firm to innovate, there is an incentive to adopt excessively risky research strategies, since it doesn't matter if one loses by a day or a decade. If patent protection is imperfect, so that rivals benefit from each others' R&D, waste is reduced, but so are incentives to invest in research (Spence (1984)).

Market structure is clearly endogenous in the presence of R&D rivalry, since success brings with it some (generally temporary) market power. A number of authors have explored the possibility of preemptive patenting to deter entry.[27] In the simplest case, an incumbent monopoly will always outbid a potential entrant for a patent on a new production process that either could use, exactly as a new plant or a new product is more attractive to an established monopoly than to a new entrant (Gilbert and Newbery (1982)). But preemption is less likely to be rational if the patent does not yet exist (since the monopoly generally has less to gain from invention), if there is uncertainty in the research process (since a potential entrant may have a positive probability of winning the patent race with even a very small-scale research effort), or if there are multiple patents that can be used to effect entry (Reinganum (1983)). In general, whether R&D rivalry tends to perpetuate concentrated market structures depends on the details of the model studied (Vickers (1986)).

Empirical Studies A number of studies make clear some of the limits of the theoretical literature.[28] Most research is devoted to the development of new products, not new processes, and development (post-invention) spending far outweighs research spending in most industries. In some industries (e.g., chemicals) patents are effective and important instruments for preventing imitation, but they can often be invented around, and in many industries (e.g., electronics) patents are neither effective nor important (Levin, Klevorick, Nelson, and Winter (1987)). In some cases the time required to copy an innovation is the main source of an innovator's rewards, even though copying is usually cheaper than innovating. It would seem that corporate R&D efforts can only rarely be well described as patent races with a single prize.

Many authors have attempted to test Joseph Schumpeter's assertions that large firms and concentrated industries are disproportionately important sources of technical progress. But, aside from very small firms, which pose particular measurement problems, R&D spending as a percentage of sales does not seem to rise with firm size in most industries (Cohen, Levin, and Mowery (1987)). Moreover, the largest firms are not disproportionately important producers of major innovations, nor are they quickest in all cases to adopt innovations originating elsewhere. And, adjusting for differences in technological opportunity, increases in seller concentration do not appear to spur R&D effort.

Schumpeter also stressed that R&D rivalry shapes market structures, a theme that runs through the theoretical literature and is broadly consistent with the arguments of Demsetz (1973) discussed above. But this mechanism has received little explicit empirical attention (Temin (1979)).

V. STATUS AND IMPLICATIONS

In this final section I offer a brief overall assessment of the state of industrial economics and discuss some implications for research priorities and policy design.

Status of the Field

Industrial economists have adopted a common theoretical language in recent years and have produced a host of formal models. This work has uncovered a number of general principles, such as the importance of credibility and the consequent value of commitment, that have proven useful in a wide variety of contexts. And our understanding of a number of classic problems, including entry deterrence and cartel stability, has been considerably advanced. But we have also learned two unpleasant features of the game-theoretic approach to the analysis of imperfect competition.

First, even apparently simple multi-period games of incomplete information often have multiple (perfect Bayesian Nash) equilibria that can be uncovered only by very sophisticated analysis. The assumption that boundedly rational humans can solve the much more complex games they face in real life seems to push the rationality assumption very far indeed. (Chess is soluble in theory, for instance, but not in practice.) But it is not clear how to replace that assumption.[29] Nor is it clear, despite a great deal of effort devoted to refining the equilibrium concepts discussed in Section I, how to deal in general with models possessing multiple perfect Bayesian Nash equilibria.

Second, the predictions of game-theoretic models seem delicate and are often difficult to test. Important qualitative features of equilibria often depend critically on whether prices or quantities are choice variables, on whether discrete or continuous time is assumed, on whether moves are sequential or simultaneous, and, perhaps most disturbing of all, on how players with incomplete information are assumed to alter their beliefs in response to events that cannot occur in equilibrium. When information is incomplete, strategies depend on unobservable beliefs, and the often empirically questionable assumption that key parameters and probability distributions are common knowledge is central to the analysis.

I do not mean at all to suggest that the game-theoretic approach should be scrapped. It can't be wrong in principle to spell out explicitly the details of the situation analyzed and to derive their implications rigorously. And there is simply no attractive alternative approach available. Still, recent theoretical research has taught us much more about what *might* happen in a variety of market situations than about what *must* happen conditional on observables.

Advances have also been made on the empirical front, particularly in the analysis of individual industries. But, while the empirical research discussed in the preceding sections has uncovered a number of interesting regularities, it has not yet managed substantially to erase the impression that "anything is possible" left by the theoretical literature. Empirical studies in most areas are still concerned with the existence of hypothesized effects rather than with precise estimation of their magnitudes. Debates still rage, for instance, on whether there is any structural relation at all between market concentration and the intensity of rivalry. Industrial

economists can thus speak the same theoretical language and yet disagree sharply as to the empirical relevance of particular theoretical results.

Research Strategies

Most central questions in industrial organization have by now received considerable game-theoretic attention; the problem is not too little theory but too many different theories. It would appear that research on the theoretical front should be aimed, at least in part, at unification of diverse models and identification of particularly non-robust predictions.

Until game-theoretic analysis either begins to yield robust general predictions or is replaced by a mode of theorizing that does so, it seems a fair bet that most major substantive advances in industrial economics will come from empirical research. Only empirical studies can reveal which theoretical models are "empty boxes" and which have wide domains of applicability. And without the discipline provided by a solid base of facts, theorists cannot be expected to concentrate on deducing the implications of empirically interesting assumptions.

Much of the most valuable and persuasive empirical research in industrial economics employs carefully-constructed data sets. In many cases these are industry-specific; most industrial economists are more confident about the workings of a few well-studied markets than about markets in general. Still other data sets use interviews or surveys to supplement government statistics or exhibit both time-series and cross-section variation. Since data collection is usually neither intellectually exciting nor highly valued by the economics profession as a whole, progress in

industrial organization may depend critically on the availability of financial support for this important activity.

Policy Design

As I noted at the start of this essay, industrial economists have long been concerned with public policies toward business, and the set of such policies has expanded in recent years. In some domains we are much better able to meet the demand for policy prescriptions than in the past; in others we have mainly learned how little we can confidently assert.

On the positive side, the conceptual and empirical tools available for the analysis of individual markets have been considerably improved.[30] The procedures now used by U.S. antitrust authorities to evaluate proposed mergers, for instance, are radically different from and, on balance, much sounder than those used in earlier decades. The quality of economic analysis in individual antitrust cases and in debates about regulatory policies affecting particular industries has risen sharply.

On the negative side, recent research has cast doubt on many positive and normative relations that were once widely believed to be generally valid. This makes it harder to speak confidently about policies that apply across the economy. In particular, it now seems clear that the level of seller concentration is at best a poor predictor of the intensity of rivalry, so that simple concentration-based rules that once seemed attractive now have little appeal.

Recent theoretical research suggests that market conduct depends in complex ways on a host of factors, and the empirical literature offers few simple, robust structural relations on which general policies can be

confidently based. Moreover, formal models of imperfect competition rarely generate unambiguous welfare conclusions. In such models, feasible policy options usually involve movements *toward* but not *to* perfect competition, so that welfare analysis involves second-best comparisons among distorted equilibria. In particular, there is no guarantee that making markets "more competitive" will generally enhance welfare, particularly if non-price rivalry is intensified.

Even though it is sometimes painful to recognize the limitations of existing knowledge, it can also be quite exciting. Industrial economics today is an intellectually lively field. And the practical importance of understanding the supply side of the economy is certainly not diminishing.

References

Abreu, D. (1986). 'Extremal Equilibria of Oligopolistic Supergames.' *Journal of Economic Theory*, vol. 39, pp. 191-225.

Arrow, K.J. (1962). 'Economic Welfare and the Allocation of Resources for Inventions.' In *The Rate and Direction of Inventive Activity* (ed. R.R. Nelson). Princeton: Princeton University Press.

Axelrod, R. (1984). *The Evolution of Cooperation*. New York: Basic Books.

Bain, J.S. (1951). 'Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940.' *Quarterly Journal of Economics*, vol. 65, pp. 293-324.

_____ (1956). *Barriers to New Competition*. Cambridge: Harvard University Press.

Baker, J.B. and Bresnahan, T.F. (1985). 'The Gains from Merger or Collusion in Product-Differentiated Industries.' *Journal of Industrial Economics*, vol. 33, pp. 427-444.

Baldwin, J.R. and Gorecki, P.K. (1985). 'The Determinants of Small Plant Market Share in Canadian Manufacturing Industries in the 1970's.' *Review of Economics and Statistics*, vol. 67, pp. 156-161.

Barton, D.M., and Sherman, R. (1984). 'The Price and Profit Effects of Horizontal Merger: A Case Study.' *Journal of Industrial Economics*, vol. 33, pp. 165-177.

Baumol, W.J., Panzar, J.C., and Willig, R.D. (1982). *Contestable Markets and the Theory of Industry Structure*. New York: Harcourt Brace Jovanovich.

Benham, L. (1972). 'The Effects of Advertising on the Price of Eyeglasses.' *Journal of Law and Economics*, vol. 15, pp. 337-352.

Brander, J.A. and Spencer, B.J. (1985). 'Export Subsidies and International Market Share Rivalry.' *Journal of International Economics*, vol. 18, pp. 83-100.

Branman, L., Klein, J.D., and Weiss, L.W. (1987). 'The Price Effects of Increased Competition in Auction Markets.' *Review of Economics and Statistics*, vol. 69, pp. 24-32.

Bresnahan, T.F. (1987). 'Competition and Collusion in the American Automobile Industry: The 1955 Price War.' *Journal of Industrial Economics*, vol. 35, pp. 457-482.

Breusch, T.S. (1986). 'Hypothesis Testing in Unidentified Models.' *Review of Economic Studies*, vol. 53, pp. 635-651.

Bulow, J., Geanakoplos, J. and Klemperer, P. (1985). 'Multimarket Oligopoly: Strategic Substitutes and Complements.' *Journal of Political Economy*, vol. 93, pp. 488-511.

Buxton, A.J., Davies, S.W. and Lyons, B.R. (1984). 'Concentration and Advertising in Consumer and Producer Markets.' *Journal of Industrial Economics*, vol. 32, pp. 451-464.

Carlton, D.W. (1979). 'Vertical Integration in Competitive Markets Under Uncertainty.' *Journal of Industrial Economics*, vol. 27, pp. 189-209.

_____ (1986). 'The Rigidity of Prices.' *American Economic Review*, vol. 76, pp. 637-658.

Caves, R.E. (1980). 'Corporate Strategy and Structure.' *Journal of Economic Literature*, vol. 28, pp. 64-92.

_____ (1985). 'International Trade and Industrial Organization: Problems, Solved and Unsolved.' *European Economic Review*, vol. 28, pp. 377-395.

_____ and Porter, M.E. (1977). 'From Entry Barriers to Mobility Barriers.' *Quarterly Journal of Economics*, vol. 91, pp. 241-267.

Chandler, A.D. (1977). *The Visible Hand: The Managerial Revolution in American Business*. Cambridge: Harvard University Press.

Cohen, W.M., Levin, R.C., and Mowery, D.C. (1987). 'Firm Size and R&D Intensity: A Re-Examination.' *Journal of Industrial Economics*, vol. 35, pp. 543-565.

Comanor, W.S. and Wilson, T.A. (1979). 'The Effect of Advertising on Competition: A Survey.' *Journal of Economic Literature*, vol. 17, pp. 453-476.

Cowling, K. and Mueller, D. (1978). 'The Social Costs of Monopoly Power.' *Economic Journal*, vol. 88, pp. 727-748.

Cowling, K. and Waterson, M. (1976). 'Price-Cost Margins and Market Structure.' *Economica*, vol. 43, pp. 267-274.

Cowling, K., *et al* (1980). *Mergers and Economic Performance*. Cambridge: Cambridge University Press.

Cubbin, J. (1975). 'Quality Change and Pricing Behaviour in the U.K. Car Industry.' *Economica*, vol. 42, pp. 45-58.

_____ and Geroski, P.A. (1987). 'The Convergence of Profits in the Long Run: Inter-firm and Inter-industry Comparisons.' *Journal of Industrial Economics*, vol. 35, pp. 427-442.

Curry, B. and George, K.D. (1983). 'Industrial Concentration: A Survey.' *Journal of Industrial Economics*, vol. 31, pp. 203-255.

Dasgupta, P. and Stiglitz, J.E. (1980). 'Uncertainty, Industrial Structure, and the Speed of R&D.' *Bell Journal of Economics*, vol. 11, pp. 1-28.

Davidson, C. and Deneckere, R. (1986). 'Long-Run Competition in Capacity, Short-Run Competition in Price, and the Cournot Model.' *Rand Journal of Economics*, vol. 17, pp. 404-415.

Demsetz, H. (1973). 'Industry Structure, Market Rivalry, and Public Policy.' *Journal of Law and Economics*, vol. 16, pp. 1-10.

_____ (1979). 'Accounting for Advertising as a Barrier to Entry.' *Journal of Business*, vol. 52, pp. 345-360.

Dickens, W.T. and Katz, L.F. (1986). 'Interindustry Wage Differences and Industry Characteristics.' In *Unemployment and the Structure of Labour Markets* (ed. K. Lang and J. Leonard). Oxford: Basil Blackwell.

Dixit, A.K. (1979). 'A Model of Entry Suggesting a Theory of Entry Barriers.' *Bell Journal of Economics*, vol. 10, pp. 20-32.

_____ and Stiglitz, J.E. (1977). 'Monopolistic Competition and Optimum Product Diversity.' *American Economic Review*, vol. 67, pp. 297-308.

_____ and Norman, V. (1978). 'Advertising and Welfare.' *Bell Journal of Economics*, vol. 9, pp. 1-18.

Domowitz, I., Hubbard, R.G., and Petersen, B.C. (1986). 'Business Cycles and the Relationship between Concentration and Price-Cost Margins.' *Rand Journal of Economics*, vol. 17, pp. 1-17.

Drèze, J.H. (1985). 'Uncertainty and the Firm in General Equilibrium Theory.' *Economic Journal (Supplement)*, vol. 95: 1-20.

Dunne, T., Roberts, M.J., and Samuelson, L. (1987). 'Patterns of Firm Entry and Exit in U.S. Manufacturing Industries.' Mimeographed, Pennsylvania State University.

Eckbo, B.E. (1985). 'Mergers and the Market Concentration Doctrine: Evidence from the Capital Market.' *Journal of Business*, vol. 58, pp. 325-349.

Evans, D.S. (1987). 'The Relationship Between Firm Growth, Size, and Age: Estimates for 100 Manufacturing Industries.' *Journal of Industrial Economics*, vol. 85, pp. 657-674.

Farrell, J. and Maskin, E. (1987). 'Renegotiation in Repeated Games.' Mimeographed, University of California, Berkeley.

Fisher, F.M. and McGowan, J.J. (1983). 'On the Misuse of Accounting Rates of Return to Infer Monopoly Profits.' *American Economic Review*, vol. 73, pp. 82-97.

Friedman, J.W. (1983). 'Advertising and Oligopolistic Equilibrium.' *Bell Journal of Economics*, vol. 14, pp. 464-473.

_____ (1986). *Game Theory with Applications to Economics*. Oxford: Oxford University Press.

Fudenberg, D. and Maskin, E. (1986). 'The Folk Theorem in Repeated Games with Discounting and with Incomplete Information.' *Econometrica*, vol. 54, pp. 533-554.

_____ and Tirole, J. (1984). 'The Fat-Cat Effect, the Puppy-Dog Ploy, and the Lean and Hungry Look.' *American Economic Review (Papers and Proceedings)*, vol. 74, pp. 361-366.

_____ and _____ (1987). 'Understanding Rent Dissipation: On the Use of Game Theory in Industrial Organization.' *American Economic Review (Papers and Proceedings)*, vol. 77, pp. 176-183.

Geroski, P.A. (1981). 'Specification and Testing the Profits-Concentration Relationship: Some Experiments for the U.K.' *Economica*, vol. 48, pp. 279-288.

_____ (1988). 'In Pursuit of Monopoly Power: Recent Quantitative Work in Industrial Economics.' *Journal of Applied Econometrics*, forthcoming.

_____, Ulph, A. and Ulph, D. (1986). 'A Model of the Crude Oil Market in Which Conduct Varies Over Time.' *Economic Journal (Supplement)*, vol. 97, pp. 77-86.

Gilbert, R.J. and Newbery, D. (1982). 'Preemptive Patenting and the Persistence of Monopoly.' *American Economic Review*, vol. 72, pp. 514-526.

Gisser, M. (1984). 'Price Leadership and Dynamic Aspects of Oligopoly in U.S. Manufacturing.' *Journal of Political Economy*, vol. 92, pp. 1035-1048.

Green, E.J. and Porter, R.H. (1984). 'Noncooperative Collusion under Imperfect Price Information.' *Econometrica*, vol. 52, pp. 87-100.

Grether, D.M. and Plott, C.R. (1984). 'The Effects of Market Practices in Oligopolistic Markets: An Experimental Examination of the *Ethyl* Case.' *Economic Inquiry*, vol. 22, pp. 479-507.

Grossman, G. and Shapiro, C. (1984). 'Informative Advertising with Differentiated Products.' *Review of Economic Studies*, vol. 51, pp. 63-82.

Gul, F., Sonnenschein, H. and Wilson, R. (1986). 'Foundations of Dynamic Monopoly and the Coase Conjecture.' *Journal of Economic Theory*, vol. 39, pp. 155-190.

Hall, R.E. (1987). 'The Relation between Price and Marginal Cost in U.S. Industry.' Mimeographed, Hoover Institution.

Harrington, J.E., Jr. (1986). 'Limit Pricing when the Potential Entrant is Uncertain of its Cost Function.' *Econometrica*, vol. 54, pp. 429-437.

Harris, M. and Townsend, R. (1981). 'Resource Allocation under Asymmetric Information.' *Econometrica*, vol 49, pp. 33-64.

Hart, O. and Holmstrom, B. (1987). 'The Theory of Contracts.' In *Advances in Economic Theory, Fifth World Congress* (ed. T. Bewley). Cambridge: Cambridge University Press.

Hay, D.A. and Morris, D.J. (1979). *Industrial Economics*. Oxford: Oxford University Press.

Hay, G.A., and Kelley, D. (1974). 'An Empirical Survey of Price-Fixing Conspiracies.' *Journal of Law and Economics*, vol. 17, pp. 13-38.

Helpman, E. and Krugman, P. (1985). *Market Structure and Foreign Trade*. Cambridge: MIT Press.

Iwata, G. (1974). 'Measurement of Conjectural Variations in Oligopoly.' *Econometrica*, vol. 42, pp. 947-966.

Jensen, M.C. and Meckling, W. (1976). 'Theory of the Firm: Managerial Behavior, Agency Costs, and Capital Structure.' *Journal of Financial Economics*, vol. 3, pp. 305-360.

_____ and Ruback, R. (1983). 'The Market for Corporate Control.' *Journal of Financial Economics*, vol. 11, pp. 5-50.

de Jong, H.W. (1986). 'European Industrial Organization: Entrepreneurial Economics in an Organizational Setting.' In *Mainstreams in Industrial Organization, Book I* (ed. H.W. de Jong and W.G. Shepherd). Dordrecht: Kluwer.

Joskow, P.L. (1987). 'Contract Duration and Relationship-Specific Investments.' *American Economic Review*, vol. 77, pp. 168-185.

_____ and Klevorick, A.K. (1979). 'A Framework for Analyzing Predatory Pricing Policy.' *Yale Law Journal*, vol. 89, pp. 213-270.

_____ and Schmalensee, R. (1986). 'Incentive Regulation for Electric Utilities.' *Yale Journal on Regulation*, vol. 4, pp. 1-49.

Judd, K.L. (1985). 'Credible Spatial Preemption.' *Rand Journal of Economics*, vol. 16, pp. 153-166.

Kamien, M. and Schwartz, N. (1982). *Market Structure and Innovation*. Cambridge: Cambridge University Press.

Krattenmaker, T.G. and Salop, S. (1986). 'Anticompetitive Exclusion: Raising Rivals' Cost to Achieve Power Over Price.' *Yale Law Journal*, vol. 96, pp. 209-295.

Kreps, D.M. and Wilson, R. (1982). 'Reputation and Imperfect Information.' *Journal of Economic Theory*, vol. 27, pp. 253-279.

Krueger, A.B. and Summers, L.H. (1987). 'Reflections on the Inter-Industry Wage Structure.' In *Unemployment and the Structure of Labour Markets* (ed. K. Lang and J. Leonard). Oxford: Basil Blackwell.

Krugman, P.R., ed. (1986). *Strategic Trade Policy and the New International Economics*. Cambridge: MIT Press.

Lau, L. (1982). 'On Identifying the Degree of Competitiveness From Industry Price and Output Data.' *Economics Letters*, vol. 10, pp. 93-99.

Levin, R.C., Klevorick, A.K., Nelson, R.R., and Winter, S.G. (1987). 'Appropriating the Returns from Industrial R&D.' Mimeographed, Yale University.

Lieberman, M.B. (1984). 'The Learning Curve and Pricing in the Chemical Processing Industries.' *Rand Journal of Economics*, vol. 15, pp. 213-228.

_____ (1987). 'Excess Capacity as a Barrier to Entry: An Empirical Appraisal.' *Journal of Industrial Economics*, vol. 35, pp. 607-627.

Mankiw, N.G. and Whinston, M.D. (1986). 'Free Entry and Social Inefficiency.' *Rand Journal of Economics*, vol. 17, pp. 48-58.

Maskin, E. and Riley, J. 'Monopoly with Incomplete Information.' *Rand Journal of Economics*, vol. 15, pp. 171-196.

Milgrom, P. and Roberts, J. (1987) 'Informational Asymmetries, Strategic Behavior, and Industrial Organization.' *American Economic Review (Papers and Proceedings)*, vol. 77, pp. 184-93.

Mueller, D. (1986). *Profits in the Long Run*. Cambridge: Cambridge University Press.

Nelson, R.R. and Winter, S.G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge: Harvard University Press.

Nicholls, W. (1951). *Price Policies in the Cigarette Industry*. Nashville: Vanderbilt University Press.

Novshek, W. (1985). 'On the Existence of Cournot Equilibrium.' *Review of Economic Studies*, vol. 52, pp. 85-98.

Oi, W.Y. (1971). 'A Disneyland Dilemma: Two-Part Tariffs for a Mickey-Mouse Monopoly.' *Quarterly Journal of Economics*, vol. 85, pp. 77-96.

Pakes, A. (1987). 'Mueller's *Profits in the Long Run*.' *Rand Journal of Economics*, vol. 18, pp. 319-332.

Panzar, J.C. and Rosse, J.N. (1987). 'Testing for "Monopoly" Equilibrium.' *Journal of Industrial Economics*, vol. 35, pp. 443-456.

Phlips, L. (1983). *The Economics of Price Discrimination*. Cambridge: Cambridge University Press.

Plott, C.R. (1982). 'Industrial Organization Theory and Experimental Economics.' *Journal of Economic Literature*, vol. 20, pp. 1485-1527.

Porter, M.E. (1976). *Interbrand Choice, Strategy, and Bilateral Market Power*. Cambridge: Harvard University Press.

_____ (1979). 'The Structure Within Industries and Companies' Performance.' *Review of Economics and Statistics*, vol. 61, pp. 214-227.

_____ (1980). *Competitive Strategy*. New York: Free Press.

Pryor, F.L. (1972). 'An International Comparison of Concentration Ratios', *Review of Economics and Statistics*, vol. 54, pp. 130-140.

Ravenscraft, D.J. (1983). 'Structure-Profit Relationships at the Line of Business and Industry Level.' *Review of Economics and Statistics*, vol. 65, pp. 22-31.

_____ and Scherer, F.M. (1988). *Mergers, Sell-Offs, and Economic Efficiency*. Washington: Brookings Institution.

Reinganum, J. (1983). 'Uncertain Innovation and the Persistence of Monopoly.' *American Economic Review*, vol. 73, pp. 741-748.

Rey, P. and Tirole, J. (1986). 'The Logic of Vertical Restraints.' *American Economic Review*, vol. 76, pp. 921-939.

Roberts, D.J. (1987). 'Battles for Market Share.' In *Advances in Economic Theory, Fifth World Congress* (ed. T. Bewley). Cambridge: Cambridge University Press.

Rose, N.L. (1987). 'Labor Rent-Sharing and Regulation: Evidence from the Trucking Industry.' *Journal of Political Economy*, vol. 95, pp. 1146-1178.

Rotemberg, J.J. and Saloner, G. (1986). 'A Supergame-Theoretic Model of Business Cycles and Price Wars During Booms.' *American Economic Review*, vol. 76, pp. 390-407.

Saloner, G. (1987). 'Predation, Mergers, and Incomplete Information.' *Rand Journal of Economics*, vol. 18, pp. 165-186.

Salop, S.C. (1979). 'Monopolistic Competition with Outside Goods.' *Bell Journal of Economics*, vol. 10, pp. 141-156.

_____ (1986). 'Practices that (Credibly) Facilitate Oligopoly Coordination.' In *New Developments in the Analysis of Market Structure* (ed. G.F. Mathewson and J.E. Stiglitz). Cambridge: MIT Press.

Scherer, F.M. (1980). *Industrial Market Structure and Economic Performance, 2nd Ed.* Chicago: Rand McNally.

_____, Beckstein, A., Kaufer, E., and Murphy, R.D. (1975). *The Economics of Multi-Plant Operation.* Cambridge: Harvard University Press.

Schmalensee, R. (1978). 'Entry Deterrence in the Ready-to-Eat Breakfast Cereal Industry.' *Bell Journal of Economics*, vol. 9, pp. 305-327.

_____ (1981). 'Economies of Scale and Barriers to Entry.' *Journal of Political Economy*, vol. 89, pp. 122-138.

_____ (1982). 'Product Differentiation Advantages of Pioneering Brands.' *American Economic Review*, vol. 72, pp. 349-365. (*Errata*, vol. 73, p. 250.)

_____ (1985). 'Do Markets Differ Much?' *American Economic Review*, vol. 75, pp. 341-351.

_____ and Willig, R.D., eds. (1989). *Handbook of Industrial Organization.* Amsterdam: North-Holland.

Schwert, G.W. (1981). 'Using Financial Data to Measure the Effects of Regulation.' *Journal of Law and Economics*, vol. 24, pp. 121-158.

Shaked, A. and Sutton, J. (1983). 'Natural Oligopolies.' *Econometrica*, vol. 51, pp. 1469-1483.

Shocker, A.D. and Srinivasan, V. (1979). 'Multiattribute Approaches for Product Concept Evaluation and Generation: A Critical Review.' *Journal of Marketing Research*, vol. 16, pp. 159-180.

Smirlock, M. and Marshall, W. (1983). 'Monopoly Power and Expense-Preference Behavior: Theory and Evidence to the Contrary.' *Bell Journal of Economics*, vol. 14, pp. 166-178.

Smith, V.L. (1982). 'Microeconomic Systems as an Experimental Science.' *American Economic Review*, vol. 72, pp. 923-955.

Spence, A.M. (1975). 'Monopoly, Quality, and Welfare.' *Bell Journal of Economics*, vol. 6, pp. 417-429.

_____ (1977). 'Entry, Capacity, Investment, and Oligopolistic Pricing.' *Bell Journal of Economics*, vol. 8, pp. 534-544.

_____ (1980). 'Multi-Product Quantity-Dependent Prices and Profitability Constraints.' *Review of Economic Studies*, vol. 47, pp. 821-842.

_____ (1981). 'The Learning Curve and Competition.' *Bell Journal of Economics*, vol. 12, pp. 49-70.

_____ (1984). 'Cost Reduction, Competition, and Industry Performance.' *Econometrica*, vol. 52, pp. 101-122.

Stigler, G.J. (1964). 'A Theory of Oligopoly.' *Journal of Political Economy*, vol. 72, pp. 44-61.

_____ (1968). *The Organization of Industry*. Homewood: Irwin.

_____ (1971). 'The Theory of Economic Regulation.' *Bell Journal of Economics and Management Science*, vol. 2, pp. 3-21.

Stoneman, P. (1983). *The Economic Analysis of Technological Change*. Oxford: Oxford University Press.

Telser, L.G. (1960). 'Why Should Manufacturers Want Fair Trade?" *Journal of Law and Economics*, vol. 3, pp. 86-105.

Temin, P. (1979). 'Technology, Regulation, and Market Structure in the Modern Pharmaceutical Industry.' *Bell Journal of Economics*, vol. 10, pp. 429-446.

Tirole, J. (1988). *The Theory of Industrial Organization.* Cambridge: MIT Press.

Varian, H.R. (1985). 'Price Discrimination and Social Welfare.' *American Economic Review*, vol. 75, pp. 870-875.

Vickers, J. (1985). 'Delegation and the Theory of the Firm.' *Economic Journal (Supplement)*, vol. 95, pp. 138-147.

_____ (1986). 'The Evolution of Market Structure When There is a Sequence of Innovations.' *Journal of Industrial Economics*, vol. 35, pp. 1-12.

_____ and Yarrow, G. (1988). *Privatization: An Economic Analysis.* Cambridge: MIT Press.

Williamson, O.E. (1985). *The Economic Institutions of Capitalism.* New York: Free Press.

Willig, R.D. (1978). 'Pareto-Superior Nonlinear Outlay Schedules.' *Bell Journal of Economics*, vol. 9, pp. 56-69.

Yarrow, G. (1985). 'Strategic Issues in Industrial Policy.' *Oxford Review of Economic Policy*, vol. 1, pp. 95-109.

Footnotes

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1. It is conventional in industrial economics to use "rivalry" instead of "competition" when markets may be only imperfectly competitive.
2. Two other limitations of this essay should be noted. First, I confine my attention to the English-language literature. Continental European research tends to have a more Austrian flavor and to stress the importance of disequilibrium behavior and the effects of institutions (de Jong (1986)). Second, because comprehensive bibliographies are available in Schmalensee and Willig (1989) and Tirole (1988), I have felt free to cite an idiosyncratic selection of classic, neglected, recent, illustrative, and atypical studies, along with some surveys, tilting toward recent writings that discuss earlier contributions. My apologies to those whose important works were thereby omitted from this essay's long but seriously incomplete bibliography.
3. For a detailed exposition of game theory, see Friedman (1986). The discussion of game-theoretic work in this essay has been heavily influenced by Fudenberg and Tirole (1987) and Milgrom and Roberts (1987).

4. The alternative *normal form* or *strategic form* condenses all this and simply gives payoffs as functions of the players' strategies. The extensive form seems to be more convenient and informative in most applications in industrial economics.

5. Some properties of such equilibria are discussed in Section III. It is worth noting that there exist plausible cost and demand functions that do not yield a unique pure-strategy Cournot equilibrium (Novshek (1985)).

6. In a Bertrand (price-setting) duopoly with differentiated products, for instance, the second mover has an advantage because he can undercut the first mover. Issues of commitment can also arise in the specification of dynamic models. The *open-loop* equilibrium concept, for instance, assumes that players decide once and for all what moves they will make at each date. Open-loop equilibria thus rest on the assumption that players can commit to ignore to their rivals' subsequent moves. (In *closed-loop* equilibria, which are generally more plausible, players' strategies consist of functions that map histories into actions (or probability distributions) at each date.) Similarly, discrete-time models involve the assumption that players cannot move within periods, so that period length (as measured by the discount factor) often affects the nature of the equilibrium.

7. If potential agents have hidden knowledge about their differences before the principal makes his hiring decision, the situation is said to involve *adverse selection*: less able potential agents, with poorer alternatives, may try harder to be hired. Information asymmetries that arise after hiring give rise to *moral hazard*: if the agent's effort cannot be directly observed, he may have little or no incentive to work

hard.

8. The analysis of agency-theoretic problems is often simplified considerably by invoking the *revelation principle* (Harris and Townsend (1981)). Suppose that possible agents differ according to the value of some parameter, θ, that the principal cannot observe directly and that affects performance. Then the revelation principle says, roughly, that any optimal scheme in which equilibrium compensation depends on θ is generally equivalent to a scheme in which the agent is asked to report his θ to the principal and is given incentives that make it optimal to tell the truth. One can thus limit attention to compensation arrangements of the latter form.

9. Since oligopoly theory deals with the relation between price and marginal cost, not with the rate of return on investment, it can be argued that the best performance measure would be the *Lerner index*, (price - marginal cost)/price. This argument has led to the use of the so-called price-cost margin, (revenue - labor and materials cost)/revenue, in some studies, but there is no reason to think that marginal cost is accurately measured by unit labor and materials cost. Moreover, rates of return on investment, not price-cost margins, should be equalized under competition.

10. Some authors have used the ratio of a firm's market value to the estimated replacement cost of its assets -- Tobin's q -- to measure profitability. This approach does not avoid accounting problems, of course, since replacement cost estimates must be based on accounting data.

11. This is the most natural and common generalization, but it ignores two problems. When capital markets are incomplete, shareholders will not necessarily vote unanimously for wealth maximization -- or for anything else (Drèze (1985)). And in strategic settings, owners' interests may be best served by managers who do not aim to maximize profit (Vickers (1985)). If the owners of a monopoly want to deter entry, for instance, they might want to hand control of the firm over to irrational managers who would be willing to incur any losses necessary to drive any entrants out of business -- as long as these managers can convince all potential entrants of their irrationality and job security.
12. There is an obvious tension between these observations and the extreme rationality assumed in many game-theoretic models.
13. Curry and George (1983) provide a useful survey of the literature on measures and determinants of seller concentration.
14. In the U.S. data, which have been most intensively studied in this respect, it appears that the variance in year-to-year firm growth rates declines with firm size, while the mean growth rate declines somewhat with both size and firm age (Evans (1987)).
15. Stigler (1968) offered an alternative definition: costs that must be borne by an entrant that were not borne by an incumbent. The main difference is that scale economies cannot constitute an entry barrier according to Stigler. The related concept of *mobility barriers*, obstacles to mimicking other firms' strategies, is often useful in industry analysis (Caves and Porter (1977)).

16. Most models of entry deterrence assume a single established firm. In oligopolies, incentives to over-invest to deter entry are reduced because deterrence is a public good but increased because investment tends to raise pre-entry profits if price is above cost. In some models the second effect dominates, and oligopolies facing potential entrants invest more (and deter entry more effectively) than a monopoly would.

17. Some recent work has treated cost advantages as endogenous, stressing the ability of firms under some conditions to advantage themselves, and possibly induce exit, by actions in input markets that differentially raise rivals' costs (Krattenmaker and Salop (1986)).

18. Most proposed policy rules for evaluating charges of predation employ tests based on market structure and cost-price relations (Joskow and Klevorick (1979)). Such rules lack formal welfare-theoretic rationales and are not well-suited for handling the sort of predation discussed in the next paragraph, though they do serve in practice to dispose of many groundless cases brought by high-cost producers.

19. Pakes (1987) and Geroski (1988) provide useful discussions of recent empirical work on the topics considered here.

20. Generalized versions of this equation appear in Cowling and Waterson (1976) and a number of later studies.

21. It is plausible to suppose that high buyer concentration would tend to reduce the effect of seller concentration on profitability. The few empirical tests of this countervailing power hypothesis have produced rather mixed results, however.

22. The argument underlying this assertion is spelled out in my chapter in Schmalensee and Willig (1989).

23. On the other hand, it is worth noting that accounting profitability differences among large firms, as well as large firms' market shares, seem to persist for long periods (Mueller (1986)).

24. A related literature studies situations in which buyers can verify quality only by use, and sellers have reputations for quality. High quality products will then be priced above cost in equilibrium and yield a flow of excess profits. If not, firms with reputations for high quality will prefer to exploit them by secretly lowering quality (and thus cost) and selling at the same price as high quality products until buyers catch on.

25. Comanor and Wilson (1979) survey much of the literature on the arguments discussed in this paragraph. These arguments are also relevant to the positive correlation between profitability and research and development intensity reported in several studies.

26. There are also interesting recent studies of technology adoption, particularly in the presence of *network externalities* (which imply that the value of a technology to any one user increases with the number of users), and on the strategic uses of patent licensing.

27. The issues discussed in this paragraph also arise in connection with the acquisition of natural resource deposits.

28. Surveys of the empirical literature are provided by Kamien and Schwartz (1982) and Stoneman (1983).

29. Note that learning arguments have very little appeal here, since allowing for the possibility of rational learning requires formulating a new and more complex game. For an interesting alternative (evolutionary) approach to this class of problems, see Axelrod (1984).

30. These developments have also made industrial economists better able to provide useful strategic advice to business decision-makers, and the academic and commercial markets have generally reacted rationally.